THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 64 Thursday, May 8, 1941 No. 1290

PUBLISHED WEEKLY

Subscription Terms (Home and Overseas): 21s. per annum.
All Subscriptions are payable in advance.

THE FOUNDRY TRADE JOURNAL
49, Wellington Street, London, W.C.2.

WARTIME ADDRESS
to which all communications should be sent until further notice:—
3 Amersham Road, HIGH WYCOMBE, Bucks.
Telegraphic Address: "Zacatecas, High Wycombe."
Telephone: HIGH WYCOMBE 1792 (3 lines).

OFFICIAL ORGAN OF
The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The Welsh Engineers' and Founders' Association
The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

PRESIDENT: 1940-41
W. B. Lake, J.P., Lake & Elliot, Limited, Braintree, Essex.

LIST OF SECRETARIES—
General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester, 3. London Office: 49, Wellington Street, London, W.C.2.
Birmingham, Coventry and West Midlands: A. A. Timmins, A.I.C., 21-23, St. Paul's Square, Birmingham, 3.
East Midlands: S. A. Horton, "Three," Mostyn Avenue, Littleover, Derby.
Lancashire: A. Boyes, "Roseville," 7, Kirkstall Road, Davyhulme, Manchester.
London (pro tem.): V. C. Faulkner, 3, Amersham Road, High Wycombe, Bucks.
Middlesbrough (pro tem.): J. K. Smithson, North-Eastern Iron Refining Company, Limited, Stillington, Stockton-on-Tees.
Newcastle-upon-Tyne: C. Lashly, Sir W. G. Armstrong, Whitworth & Company (Ironfounders), Limited, Close Works, Gateshead.
Scottish: J. Ball, 60, St. Enoch Square, Glasgow.
Sheffield: T. R. Walker, M.A., F.I.C., 11, Broomgrove Crescent, Sheffield, 10.
Wales and Monmouth: J. J. McClelland, 12, Clifton Place, Newport.
West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue, Ecclashill, Bradford.
South Africa: F. C. Williams, Mutual Building, Corner of Harrison and Commissioner Streets, Johannesburg.

Bristol: A. Hares, 2, Heyford Avenue, Eastville, Bristol, 5.
Burnley: H. Buckley, Ellsmere, Norfolk Avenue, Burnley, Lancs.
East Anglian: J. L. Francis, 12, Glenhurst Avenue, Colchester Road, Ipswich.
Falkirk: T. R. Goodwin, "Viewfield," Falkirk Road, Bonnybridge, Scotland.
Lincoln: E. R. Walter, M.Sc., The Technical College, Lincoln.

The Institute of Vitreous Enamellers

President: Professor J. H. Andrew, D.Sc., Department of Applied Science, The University, St. George's Square, Sheffield.
Chairman: W. H. Whittle, W. H. Whittle, Limited, Eccles, near Manchester.
Hon. Secretary: Dr. G. T. O. Martin, 21-23, St. Paul's Square, Birmingham, 3.

Foundry Trades' Equipment and Supplies Association

President: G. E. France, August's, Limited, Thorn Tree Works, Halifax.
Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association

President: W. E. Clement, Morfa Foundry, New Dock, Llanelly.
Secretary: J. D. D. Davis, 9, Royal Mutual Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION
The Registered Office and Laboratories of the B.C.I.R.A. are:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
Telephone: Colmore 4274-4275 Telegrams: CIRA
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk
Telephone: 332

Contents

	PAGE
A Critical Situation	309
The W.Y.B. Process for Reclamation of Swarf	310
Institute of British Foundrymen	310
Catalogue Received	310
Notes from the Branches	310
Random Shots	310
The Iron and Steel Institute	311
Effects of Scrap in the Blast-Furnace Burden	313
Factors in the Production of Sand Castings in High Duty Iron	315
Third Report of the Oxygen Sub-Committee	317
Automatic Firing and Control for Foundry Stoves	319
A Canadian Works Locker System	320
The Week's News in Brief	322
Trade Talk	322
Personal	322
Obituary	322
Company Meeting	322
Reports and Dividends	322
Contracts Open	322
Raw Material Markets	324

A Critical Situation

It is well known that matters have reached a crisis in the affairs of the Ironfounders' National Confederation, and that a circular is being despatched in the near future asking whether the members desire its continuation or whether it should be wound up. This position has arisen primarily because the members of the general committee cannot agree as to the basic principle upon which the Confederation should be established and operated. Some desire the I.N.C. to function as a confederation of existing employers' associations, whilst others insist upon the continuation of direct representation from the individual foundries. *Actually, however, there is unanimity in that all enthusiastically support the creation of a strong, overriding, essentially representative body for the whole of the ironfounding industry.*

Obviously, this is a time for plain speaking of a constructive character. Thus, to establish such a body as everyone envisages, there must be one of the three following structures:—(1) An organisation, of which the two main branches are representatives from the district associations and delegates from those sections of the industry which are cemented together by trade associations. Additional representation of important interests could, of course, be carried out by co-opting. (2) An organisation founded solely upon membership by the individual firms; and (3) one as at present constituted, which is a compromise between (1) and (2).

Factors apparently operating against the first type of organisation are that there are a number of large and enthusiastic concerns which support the I.N.C., yet cannot, or will not, join the district associations. Their avenue of escape, then, to use an Irishism, is by entrance through a trade group. Of importance, too, is that most of the district associations are already banded together through the National Ironfounding Employers' Federation. Obviously, under scheme (1), this representation becomes redundant, as its continued existence would constitute a cabal within the proposed governing body. Moreover, any services that it could give would be duplicating the work of the parent body. Generally speaking, whilst the members of the N.I.E.F. support the idea of the I.N.C. to be based on association representation, yet the largest trade group is adverse to such a scheme.

The second scheme is so difficult to organise, especially under existing conditions, that it warrants no further consideration. The third proposition, now in existence, is that the membership of the I.N.C. should be made up of "independent" (a badly misused word which should be replaced by "non-federated" or "non-associated") concerns and representatives from the trade organisations. Unhappily, this system has resulted in so much bickering that the present position has arisen, and the onus of solving the problem or reconciling the protagonists has been thrown on to the individual members. *It can be assumed that the industry as a whole will endorse the unanimous expression of the Council that the existence of some form of national representative body is essential.* Such a body is obviously essential to deal now with the State departments to regulate such questions as selling prices; insurance of customers' patterns under the War Damage Act; reserved occupations; expansion of trade; telescoping of industries; and matters of such character likely to arise in the future. Then, after the war, there will be the usual negotiations with the pig-iron masters, the railway rates tribunal, tariff commissioners, standardisation bodies and the organisation of campaigns against encroachment by plastics, cements, asbestos, and a host of other substitutes which are gaining ground under the influence of the Wartime Building Materials Schedules.

Thus, it seems clear that the answer of the industry to the *questionnaire* they will receive must be "Carry on," and make the work of the I.N.C. so indispensable to the industry that the fabric of its constitution, however illogical, becomes of minor importance.

C

The W.Y.B. Process for Reclamation of Swarf

It has been estimated that swarf and turnings from iron and steel machining operations amounts to between 50,000 to 500,000 tons annually in the United Kingdom. This material, except when excessively deteriorated by oxidation, is of excellent quality metallurgically. Its only disadvantage is its shape, size, and low density in bulk. For this reason it is not in great demand and commands a low market price. No matter where engineering operations are carried out there is always a steady source of supply of this raw material and at the present time, more than ever before, all such sources should be carefully considered with a view to their proper exploitation.

In the case of foundries close to engineering works the return and immediate consumption of this material would, of course, be ideal since the composition and quality of the swarf would be known; rail transport would be eliminated, and the ultimate need for pig and ore from overseas reduced. Even when ore is available at home the fuel consumption in smelting and the consequent remelting of the pig produced would be eliminated to an extent corresponding to the amount of swarf used.

A contribution to this problem has recently been made in the form of the W.Y.B. process whereby swarf or turnings are used as a cooling medium for liquid metal. This process combines two projects, *i.e.*, it provides a method of automatically dealing with liquid metal to be pigged, such as "over metal," or remelted metal, and of incorporating further quantities of cold swarf in the final product. The mechanical equipment developed for this purpose is simple and robust and is designed to combine portability while at the same time meeting the conditions of the process.

It consists of a rotating drum or barrel set at a predetermined angle, into which is fed, by hand, or by overhead hopper, the cast iron or steel swarf. Whilst this is rotating, liquid metal to be pigged is brought up and poured into the drum where it combines with the rolling swarf and forms rough lumps consisting of cold material compactly united into a dense clinker of size varying from, say, 10 lbs. weight to over 50 lbs. With cast iron as the cold material partial fusion produces smaller lumps of smooth appearance in which the swarf does not change in composition, *i.e.*, there is no melting loss or pick-up of impurities.

In the case of steel cuttings or swarf which is a material quite unsuitable for cupola melting, the same advantages apply and the resultant rough mass is an excellent base material for high-duty irons since there is no carbon pick-up in the absorption process. It has also been found that this material melts faster and hotter in the cupola, an increase from 6 to 7 tons per hr. having been obtained in practice, and there is no increase in iron loss to the slag over extended operation on this material.

Steel in the usual scrap form is far from ideal for cupola melting owing to its tendency to melt at a different rate when charged with cast iron. However, a material consisting of cast iron and finely divided steel would be expected to have a lower melting point, somewhat like an eutectic, and this is what happens in practice. The incorporation of other materials such as carbon, ferro-alloys, etc., is possible by the same process where the purity of the additions is up to the required standard, and here again the melting loss would be eliminated.

The actual savings to be expected depend to some extent on the internal system of costing in the particular foundry, but to begin with cast-iron borings may be assessed at 25s. per ton, and steel cuttings at 40s. per ton, whereas pig-iron is 130s. and heavy machinery scrap for cupola melting 100s. These figures alone sug-

(*Continued in next column.*)

(*Continued from previous column.*)

gest savings even with remelting costs allowed for, and it has been found that where metal used in the process is melted, as for making castings, the saving, using steel swarf with the normal absorption of 33 per cent. cold material is about 20s. per ton of product made. If cast-iron borings, dressing-shop floor metal, sprigs and splash metal are melted for pigging and used in this process to obtain absorption of swarf, the saving in the primary process will be enhanced to the extent indicated.

A metal bucket placed in front of the casting machine receives the lump material which travels out and is discharged automatically as it forms. This simplifies the handling problem as loads of about 2 tons are removed at one lift. This process, which is protected, and the required machine, is handled by Messrs. John McDonald & Son, of Nitshill, near Glasgow.

Institute of British Foundrymen

MR. PERCY PRITCHARD AWARDED E. J. FOX GOLD MEDAL

At a meeting of the Council of the Institute of British Foundrymen, held in Manchester on April 19, 1941, the recommendation of the Assessors for the E. J. Fox Gold Medal (Sir Wm. Larke, K.B.E., and Dr. J. E. Hurst) that the Medal for 1941 be awarded to Mr. Percy Pritchard was unanimously endorsed. The presentation will be made at the Annual General Meeting of the Institute. The award has been made to Mr. Pritchard in recognition of the scientific and technical contributions which he has made to the development of the foundry industry, particularly in the light aluminium and magnesium alloy fields. Mr. Pritchard is managing director of the Birmingham Aluminium Castings (1903) Company, Limited, Birmid Industries, Limited, the Midland Cylinder Company, Limited, and Dartmouth Auto Castings, Limited.

Annual General Meeting

The Council also decided that the Annual General Meeting of the Institute will be held at the Midland Hotel, Manchester, on Saturday, July 12, 1941. The business meeting will be followed by a technical session, at which four Papers will be presented for discussion. The Papers are:—

(1) "American Synthetic Sand Practice," by Norman J. Dunbeck (American exchange Paper).

(2) "Mould and Core Washes; their Preparation and Possible Methods of Testing," by W. Y. Buchanan.

(3) A Paper on "Practical Difficulties in Making Non-Ferrous Admiralty Castings," by F. Hudson.

(4) A Paper on "British National Specifications for Grey Cast Iron," by J. G. Pearce, M.Sc., M.I.E.E.

Notes from the Branches

London.—Sir John Wardlaw-Milne, K.B.E., is to be the principal guest at the luncheon which is being held at the Dorchester Hotel on Saturday. Sir John is chairman of the Committee on National Expenditure.

Catalogue Received

Fixing Devices. The Rawlplug Company, Limited, of Cromwell Road, London, S.E.7, have just released the 42nd edition of their catalogue, containing the latest price revisions. It carries 22 extensively illustrated pages and introduces a fair number of lines other than the well-known Rawlplugs, such as anchoring bolts, hammers, drills and similar equipment.

Random Shots

In his speech at the Iron and Steel Institute luncheon in London last week, the Prime Minister of Australia, Mr. Menzies, said how much at home he felt with kinsmen on either side of him; Mr. John Craig, the President, on the one hand, and Sir Andrew Duncan on the other. But as if that were not enough triumph for that hardy race, he went on to claim Dr. Swinden, the recipient of the Bessemer Medal, as a brother Scot! And this was odd, because Dr. Swinden is not only a Yorkshireman, but a Sheffielder withal. As Mr. Menzies explained, anyone who spoke of "worrrk" in the way that Dr. Swinden did could leave no doubt in his mind as to his origin. One might imagine that long association with the heads of the iron and steel industry in Sheffield had caused that Scottish *r*, but "Marksman" has it on good authority that Dr. Swinden rolled the *r* in "work" even in his University days. This is the only bit of Glasgow in his vocabulary.

* * *

Incidentally, whilst on the subject of Scottish pronunciation, many a mere Englishman has wondered why in the land of his ancestors Mr. Menzies is known as Mr. Mengies. The explanation undoubtedly lies in the ancient spelling of the name, which was written *Mengnes*. It is interesting to learn also that according to Scottish records the larch was introduced into Scotland by one Menzies of Culdares, who brought over seven saplings from the Tyrol. Two of these, reputed to be the most gigantic specimens in the country, are still flourishing in the Dunkeld grounds of the Duke of Athol. The modern Menzies of Australia is doing a similar signal service to his mother country in sending saplings of yet a nobler kind to glorify the cause of the free world.

* * *

The following story has the double distinction of being both good and true. Its veracity is vouched for by Mr. J. King, of the East Anglian Section of the London Branch. At the Lyceum Theatre at Ipswich an impassioned actor was doing his stuff. "—— Because . . . . because . . . . " he cried, reaching the climax of his oration. Just at that moment a stentorian voice from the pit interrupted with "Aye, its always the B cores, never the B moulds!"

* * *

A youngster, too much coddled at home, had gone away to boarding school for his first term. He had hardly been there a week when a pathetic letter arrived at home. "Dear Mother," it ran, "I've got an awful cold and Matron is giving me nothing but handkerchiefs for it."

* * *

In a special "Aid for Britain" edition of a Pittsburgh newspaper an enterprising journalist writes this of England: "For those who die, while air raid sirens scream insanely amid the din of the anti-aircraft batteries, the deep-throated snarl of enemy bombers overhead, the earth-shaking cr-r-rump of hurtling bombs, there is little that can be done." In case those good-hearted friends should get a wrong impression, it should be stated at once that no self-respecting Wailing Willie would scream insanely *amid* the din of anti-aircraft batteries. His woeful wail is supposed to come first, and it is considered very bad taste on his part if he doesn't give one sufficient time to get into the shelter—or to stay where one is according to temperament. Nevertheless, as his effort must have helped considerably to achieve the magnificent sum of £6,000 in one day, he will be forgiven!

"MARKSMAN."

The Iron and Steel Institute

ANNUAL MEETING IN LONDON

The Annual Meeting of the Iron and Steel Institute was held in London last week at Grosvenor House, Park Lane, Mr. John Craig, C.B.E., in the chair. On this occasion the meeting was restricted to one day and the sessions were somewhat shorter than usual owing to the many calls on members' time. In view of the circumstances, the annual dinner was not held, but members had the opportunity to meet their friends at a luncheon which preceded the main technical session. The Rt. Hon. R. G. Menzies, P.C., K.C., LL.D., Prime Minister and Minister for Co-ordination of Defence, Australia, was the guest of honour, and proposed the toast of "The Iron and Steel Institute and Industries." At this function, also, the Bessemer Gold Medal was presented to Dr. T. Swinden. After the luncheon, and prior to the discussion of Papers, routine business was conducted, and scrutineers were appointed to examine the voting lists, later reporting that the complete list was in order; the applicants were therefore admitted to membership.

The Papers presented for the meeting, and which are to be included in the No. 1 Volume of the "Journal" for 1941, are as follow:—

(1) H. Morrogh: "The Metallography of Inclusions in Cast Irons and Pig-irons."

(2) T. F. Russell: "The Thermal Relations between Ingot and Mould." (Paper No. 4/1940 of the Committee on the Heterogeneity of Steel Ingots (submitted by the Stresses in Moulds Panel of the Ingot Moulds Sub-Committee).)

(3) L. Northcott: "The Influence of Turbulence upon the Structure and Properties of Steel Ingots."

(4) H. Morrogh: "The Polishing of Cast-Iron Micro-Specimens and the Metallography of Graphite Flakes."

(5) E. S. Taylerson: "Atmospheric Corrosion Tests on Copper-Bearing and Other Irons and Steels in the United States." (Paper No. 4/1940 of the Corrosion Committee (communicated by Dr. W. H. Hatfield, F.R.S.).)

(6) E. M. Trent: "The Formation and Properties of Martensite on the Surface of Rope Wire."

(7) "Third Report of the Oxygen Sub-Committee." (Paper No. 5/1941 of the Committee on the "Heterogeneity of Steel Ingots (submitted by the Oxygen Sub-Committee).)

(8) "Intercrystalline Cracking in Boiler Plates." A Report from the National Physical Laboratory.

Nos. 1, 2 and 3 were discussed at the technical session, and discussion by correspondence on all the Papers is invited up to May 15.

REPORT OF COUNCIL

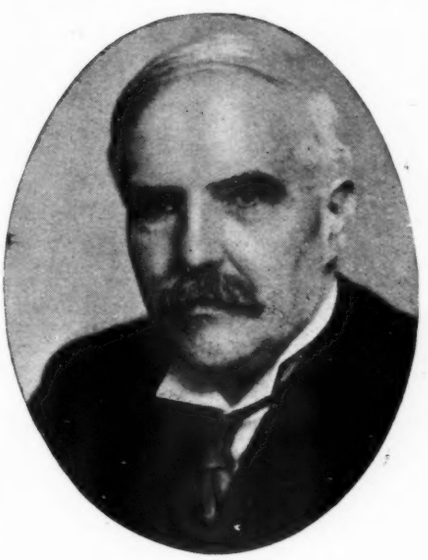
The Report points out that the activities of the Institute have been maintained, but they have been adjusted to meet wartime conditions. Both the Annual and Autumn Meetings were held, and, though the programmes were necessarily curtailed they were well attended and the discussions were satisfactory.

The membership of the Institute at December 31, 1940, was 2,666, a decrease of 38 from the record figure of the previous year. In addition, the names of 97 members resident on the Continent whose subscriptions had not been paid before the end of the year have been placed on a suspense list. These include 50 members resident in Belgium, Czechoslovakia, France, Norway, Poland and Rumania and 45 members and two associates resident in Finland, Yugoslavia, Spain and Sweden.

Four honorary members, one life member and 73 ordinary members of German or Italian nationality have ceased to be members of the Institute, in accordance with Bye-Law No. 36.

The decrease in membership is due to the extension of the war and consequent inability of members resident in many countries in Europe to remit subscriptions. A further reduction, not exceeding 160, in the number of members resident on the Continent must be anticipated, and it is proposed that those whose subscriptions have not been paid before the end of the year shall also be placed on the Suspense List as from January 1, 1941.

During the year under review 156 new members and 61 new associates were elected. These include 97 members and 25 associates nominated by companies which subscribe to the Special Subscriptions Fund, and 26 members and 27 associates who joined under the scheme of collaboration with the Institute of Metals. Two associates were elected under the special arrangement with the American Institute of Mining and Metallurgical Engineers and one under the arrangement with Jernkontoret. Nineteen associates were transferred to membership and five former members were reinstated. Thirty-nine members and 2 associates resigned and the deaths of 31 members were reported.



MR. JOHN CRAIG, C.B.E.
(President of the Iron and Steel Institute).

The balance sheet shows that the Institute's reserves were strengthened during the year, and the income and expenditure account that the war had had little adverse effect on current finances, largely owing to substantial economies. A reduction in several sources of income must, however, be anticipated in future. Both accounts show the importance of the House Fund and of industrial subscriptions in assuring a satisfactory financial position.

While income, apart from special contributions from industrial subscriptions, decreased by £417 (from £14,224 to £13,807), expenditure was reduced by £1,555 (from £18,279 to £16,724). Income from special contributions increased by £867 (from £4,166 to £5,033), resulting, after transference to reserve and other accounts, in a final excess of income over expenditure for the year of £530 (in place of £228 excess of expenditure over income during the previous year). Income from subscriptions was less by £421 and from sales of publications by £141; further reductions under both these headings must be anticipated as the result of the extension of the war. Economies have been effected wherever they have proved compatible with maintaining the service given to members, the largest items being £1,404 reduction in publishing expenses and £435 reduction in the cost of stationery, printing, postage, etc.

Though gross expenditure on salaries, National Insurance and Staff Superannuation Fund increased by £648 (from £7,136 to £7,784), including the payment for part of the year of war bonus and of the salary of a night watchman whose employment was necessitated by the danger of fires from air raids, the net increased cost to the Institute was only £95, as substantial sums were contributed by reason of the war-time activities of the members of the staff. Repairs and decorations and air-raid precautions cost £439 (as against £24 in 1939), but this figure includes the expenditure of £327 on air-raid precautions carried out in 1939 and charged against the House Fund in last year's accounts but now written off. There were no marked changes in the other items.

During the year the following changes on the Council were made: Mr. John Craig, C.B.E., succeeding the Right Hon. the Earl of Dudley, M.C., as President at the Annual Meeting. Sir Edward J. George was nominated as Honorary Vice-President. Mr. Fred Clements and Capt. R. S. Hilton were nominated Vice-Presidents, and Mr. G. H. Latham and Mr. C. J. Walsh were elected Members of Council. Mr. Walsh died on February 22, 1941, and Mr. A. O. Peech on March 22, 1941.

Honours Conferred on Members
(To December 31, 1940.)

The Council offer their warm congratulations to members of the Institute on honours and appointments received during 1940.

Sir Andrew Duncan, G.B.E., M.P., who on the outbreak of war had been appointed Controller of Iron and Steel, joined the Cabinet as President of the Board of Trade, was summoned to the Privy Council and later became Minister of Supply; he was succeeded as Controller of Iron and Steel by Col. Sir Charles Wright, Bt., K.B.E., C.B.

Many members of the Institute hold important positions in the Iron and Steel and other Controls of the Ministry of Supply or are serving on technical and advisory Committees.

The Bessemer Gold Medal for 1940 was awarded to Dr. Andrew McCance in recognition of his original investigations into the application of the laws of physical chemistry to open-hearth process and his critical examination of the thermo-dynamics of the process; of his valuable scientific Papers; and of his services in the application of science to the iron and steel industry in Scotland.

No award was made of the Andrew Carnegie Medal during 1940.

The Williams Prize of £100 for 1940 was awarded to Mr. B. Yaneske for his Paper on "The Manufacture of Steel by the Perrin Process." The Paper is printed in the No. II volume of the "Journal of the Iron and Steel Institute for 1940."

No Papers were submitted in 1940 in competition of the prize offered by Captain C. A. Ablett, O.B.E., B.Sc., M.Inst.C.E., managing director of the Cooper Roller Bearings Company, Limited. The Council have gratefully accepted Captain Ablett's offer to renew the prize, value £50, for 1941; by agreement with him, the conditions governing the award have been altered and are now as follow:—

(*a*) Competing Papers shall deal with a subject connected with engineering in iron or steel works.

(*b*) Competing authors shall be British subjects employed in the iron and steel indus-

tries of Great Britain or the British Empire. The competition shall be open to both Members and Non-Members of the Iron and Steel Institute.

(*c*) The decision of the Council of the Iron and Steel Institute shall be final as to whether a Paper is eligible and on all matters arising out of the award of the prize.

Institute Luncheon

MR. JOHN CRAIG, C.B.E. (President), presided at a luncheon held at Grosvenor House, when, as already indicated, the Right Hon. R. G. Menzies, P.C., K.C., LL.D. (Prime Minister and Minister for Co-ordination of Defence, Australia), was the principal guest. Among other guests present were the following:—His Excellency M. Bjorn Prytz (Swedish Minister), His Excellency M. Josef Bech (Minister of Foreign Affairs, Luxemburg), His Excellency M. Ivan Soubbotitch (Yugo-Slav Minister), the Rt. Hon. S. M. Bruce, C.H., M.C. (High Commissioner for Australia), Sir Andrew Duncan, G.B.E., M.A., LL.D. (Minister of Supply), Mr. James Henderson, Sir William Larke, K.B.E. (Director, British Iron and Steel Federation), Sir William Bragg, O.M., K.B.E., F.R.S. (Director, Royal Institution), Dr. W. H. Hatfield, F.R.S., Mr. E. J. Fox, Dr. T. Swinden, and Mr. R. Alsop.

The PRESIDENT, presenting the Bessemer Gold Medal for 1941 to Dr. T. Swinden, Director of Research, United Steel Companies, Limited, said that the Council had determined with complete unanimity that the medal should be presented this year to Dr. Swinden. The terms of the award were officially declared to be that it was made "in recognition of the value of the recipient's original investigations into the metallurgy of steel and of his eminent services to the organisation and direction of research in the steel industry." We who know Dr. Swinden, said the President, well knew that the Council had acted not only wisely, but well, in selecting him for this high honour. Dr. Swinden had rendered great service by his investigations into tungsten steel as well as by his close study of molybdenum in steel. His most important recent work was an investigation of the properties of cold-rolled steel and of the control of grain size, that work having been described in Papers published in the "Journal" of the Institute. Dr. Swinden's work had not been confined to theoretical studies of the problems with which he had dealt. He had built up one of the finest research organisations in the country. He took a leading part in the direction of organised research for the industry and was chairman or vice-chairman of numerous research committees. He also rendered great service to this country by giving advice of the greatest value to various Controls.

"If I may add something of more personal interest," continued the President, "I would say that Dr. Swinden is very well known in Sheffield and has shed further light even in that enlightened place, and I am sure that Sheffield is very willing to join with us in doing him honour this afternoon."

DR. T. SWINDEN, in acknowledging the award, said that in normal circumstances the recipient of this signal honour availed himself of the opportunity to say something of his work and his aspirations, but in the present circumstances he could not do so. He was permitted to say, however, how deeply sensible he was of the very great honour and to thank the President for the all too kind terms in which he referred to the work for which the Council had thought him worthy to receive this award.

Concluding, Dr. Swinden said that he looked upon the award as a further incentive to service of the Institute and the industry, and that it would be his pleasure to endeavour to do his utmost to act up to that incentive.

The RIGHT HON. R. G. MENZIES, P.C., K.C., LL.D., proposing the toast of "The Iron and Steel Institute and Industries," said that there was a time, many years ago, when wars were conducted by small bodies of men, and when communities went on their ordinary business, sometimes hardly conscious that a war was going on. That time, however, has passed; and as technique has developed and as scruples have become less, war has spread its net further and further, until now we find ourselves engaged in a war that has been called a total war, in which nobody who is within range of any instrument of death can regard himself or herself as being on anything less than active service. The people of this country are without exception in war and at war, and more and more as time goes on they realise, just as we in Australia and the people of America begin to realise, that to win a total war you must have a total organisation of all your resources. Moreover, the longer this war goes on, the more we realise its most outstanding characteristic. There has been, I suppose, no previous war in history in which so many conquests have taken place in so short a time. It is true that Napoleon ultimately found his way across the whole of Europe, but it took him years to do it. Hitler finds himself to-day straddling most of Europe, and at all material times it has taken him only a matter of weeks to achieve each conquest. This war has been going on for over a year and a half, and, although Europe has never seen such conquests before in so short a period, the casualties have been a mere fraction of those expected when the war began.

DR. T. S. SWINDEN
(*Bessemer Gold Medallist*).

Dr. Swinden is Director of Research for The United Steel Companies, Limited, Sheffield. He is also a director of Samuel Fox & Company, Limited, Distington Hematite Iron Company, Limited, and the British Magnesite Corporation, Limited. He studied metallurgy at Sheffield under Professor Arnold, and subsequently proceeded with an 1851 Exhibition Scholarship, to Sweden, where he worked in the Universities of Stockholm and Upsala and in Swedish steel works. From 1909 to 1913, Dr. Swinden was a Carnegie Research Scholar and was awarded the Carnegie Gold Medal for his researches on tungsten and molybdenum steels. Prior to taking his present position in 1932, he was respectively Chief Chemist, Chief Metallurgist and Works Manager of Samuel Fox & Company, Limited, which is one of the constituent Works of The United Steel Companies, Limited. Dr. Swinden is a member of the Council of the Iron and Steel Institute, the Advisory Committee of the National Physical Laboratory, and the Iron and Steel Industrial Research Council of the British Iron and Steel Federation. He is Vice-Chairman and an active member of the Joint Committees of the British Iron and Steel Federation and the Iron and Steel Institute dealing with the Heterogeneity of Steel Ingots, Corrosion and Alloy Steels Research. He is a member of the Research Council of the Institute of Welding and Chairman of the Committee dealing with the Weldability of Ferrous Materials. He is also Chairman of the Joint Committee of the British Iron & Steel Federation and the British Refractories Research Association dealing with refractory materials for the tin and steel industry. Dr. Swinden is responsible for the organised collaborative work on the determination of oxygen in steel, a report of which was presented at the meeting. He is a past president of the Sheffield Branch of the Institute of British Foundrymen.

Continuing, the speaker said that these facts have demonstrated that this is a war in which the factory and the machine are much more important than at any previous time in the history of the world. If there are any people left in the British world who still want to talk in terms of numbers, let us hope that they will abandon this habit while there is yet time. In this war, we have to estimate our strength by asking ourselves what industrial power, translated into terms of machines of war, we can put into the hands of the soldiers that we have.

We are a slow-moving people. I say that not with pride but with regret. We have too great a tendency to think in terms of history. It took us some time to realise that the industrial efficiency of the individual was very largely conditioned by the number of horse-power that he had at his elbow. We must realise in this war that the efficacy of the British Armies will depend not only on the courage and skill of their men, but also upon the number of tanks and other vehicles and upon the number of guns with which we have been able to equip them. This is therefore an industrial war, and the work being done by the heavy industries of the British world is therefore vital, so vital that I think, that everyone in the iron and steel industry should be regarded as being on active service. In the most literal sense, the iron and steel industries have gone to war.

Speaking on behalf of one Government in the British Empire, he said he wanted to say that nothing can ever adequately express the debt of Governments and of peoples to the great iron and steel industries, not only of Great Britain but of the British world. It is only a few years ago that those concerned in the iron and steel industry in this country used to say to me "Your wheat and your wool and your butter are excellent, but why do you, with your small population, set about making iron and steel? Why do not you leave that to us?" In the last few months, however, I have reflected that if we had stuck to making butter, would Lord Woolton be able to give it to you to-day, and if we had stuck to growing wheat and meat, would they be on your tables to-day? Would the shipping problem be any less? Would the Battle of the Atlantic be less important if we had done these things? Of course not; but Australia would have been less important in this war. Instead of being one of the really great manufacturers of munitions, she would have required to import them.

I do not say that to stir up any echoes of those past debates, but because I want to add this: My country could not at this moment be making such great progress in all forms of engineering production for war if it were not for the iron and steel industry of Australia. We see not only the iron and steel industry of this country as the backbone of the defence of Great Britain, and the iron and steel industry of America as the foundation of our ultimate crushing victory, but we see also the iron and steel industry of Australia as the basis upon which the greatest effort of our lifetime is being put forth. It is impossible for any guest of yours to lay excessive emphasis upon the importance at this time, of the industry that you represent. When some historian in the future looks back on this war, he will recall the courage shown by the men and women who are fighting for this country, but above all he will say that in this war the real foundation of success was laid by those who did not think that they were on active service, who did not wear uniform, who worked in grimy factories juggling with masses of molten metal; because he will say, this was the beginning of an age in which the industries of any country were seen to be among the great fighting services of the country. When that has been recorded, I believe that the position of the iron and steel

(*Continued on page* 320.)

Effects of Scrap in the Blast-Furnace Burden*

By C. L. T. EDWARDS

(slightly abridged)

In the preparation of this Paper, the author has drawn upon experience with the operation of a blast furnace on a 100 per cent. scrap burden, which he believes was the first operation of its kind in America. It is the writer's further belief that much of the controversy attending discussions of this subject may be obviated by the presentation of a group of facts that should be known by blast-furnacemen and open-hearth men alike.

The following question has been raised: "Is iron made with scrap in the blast-furnace charge as good iron as that made without scrap—made with straight ore?" This question may be answered in part by the fact that the open-hearth staff of the Bethlehem Steel Company, who used pig-iron from a blast furnace that operated on 100 per cent. steel scrap, found no difficulty in the processing of such iron other than that to be expected from the known analysis.

Operation with 100 per cent. Steel Scrap

During the last war there was accumulated at the Bethlehem plant of the Bethlehem Steel Company some 22,000 tons of alloy-steel turnings and borings. This scrap material was highly corroded and, like alloy-steel turnings of that period, were as a drug on the market.

* A Paper read before the American Institute of Mining and Metallurgical Engineers and printed in "Metal Technology."

[We have not viewed this Paper, perhaps, from the angle anticipated by the Author, rather have we looked at the coke consumption per ton of iron produced. Apparently 18,000 tons of pig iron made from turnings required 9,200 tons of coke. The coke had to carburize the turnings, reduce a certain amount of rust, whilst valuable combustible gases were produced. Yet we cannot help but think that cupola could make a better showing from the economical aspect.]

There was also a small tonnage of scale, rich in valuable metal. If this scrap could be worked up into pig-iron, it would become readily available for use in the open hearth.

In order that the pig-iron should contain the maximum percentage of nickel, permission was obtained from the management to try a 100 per cent. scrap operation. Accordingly, a blast furnace was swung over on July 25, 1919; the percentage of steel scrap increased more or less irregularly until July 29, when 100 per cent. steel turnings were charged. Except for occasional charges of nickel scale as an "extra," the operation continued uninterruptedly until August 27, when the furnace was swung back to the regular ore—ore and scrap—operation. During this period, the furnace production ranged from a low output of 568.60 tons to a maximum of 766.07 tons.

At the swing-over from 100 per cent. scrap to the regular burden, the charge hung up rather severely. While the latter condition has nothing to do with the object of the Paper, a brief discussion of the experience will appear later because of the interest it may have for blast-furnace operators.

In Table I, results of the first and last days of the ore charge are shown, July 25 and July 29. The last column shows a summary for the period of maximum scrap charge.

The furnace employed had a hearth 16 ft., bosh 22 ft., stock line 15 ft. 6 in., bell 11 ft. 6 in., batter ¾ in., bosh angle 73 deg. 27 min., and a Baker-Neuman top, with gas-engine blowers.

Product

Pig-iron Average for Run: C, 4.58; Si, 1.08; Mn, 0.535; S, 0.032; P, 0.0619; Ni, 2.106; Cr, 0.90 per cent.

Slag Average: SiO_2, 36.24; Al_2O_3, 8.83; S, 1.22 per cent.

Unquestionably, if a run of this sort were to be repeated to-day, a substantial improvement all along the line would be anticipated. Better furnace distribution would be obtained because of the modern filling system. A siliceous material of more uniform analyses would be used and a far superior grade of basic flux is available. In retrospect, the venture proved a success from the start, although there had been considerable misgiving concerning the feasibility of such an operation. All of the pig-iron produced was used in the production of forging steels of the highest quality, and no difficulty was reported from the metallurgical or open-hearth departments.

In the production of pig-iron from 100 per cent. steel scrap, the physical quality of the

TABLE I.—*Operation on Nickeliferous Pig Iron.*
D Furnace in 1919.

Charge and products	July 25.		July 29.		August 4.		August 9.		August 17.		August 24.		July 30 to August 25.	
	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.	Tons.	Per cent.
Ore														
Daiquiri	375.0	50.0	—	—	—	—	—	—	—	—	—	—	—	—
Ontario	225.0	30.0	102.0	80.0	—	—	—	—	—	—	—	—	10.7	—
Charlotte	151.0	20.0	—	—	—	—	—	—	—	—	—	—	—	—
Scale	—	—	25.5	20.0	—	—	63.4	Extra	32.1	Extra 32.2 T	—	—	968.0	—
		Pounds per round		Pounds per round		Pounds per round		Pounds per round		Pounds per round		Pounds per round		Pounds per round
Scrap, etc.														
Turnings	168.0	—	659.0	—	628.6	—	634.0	—	738.4	—	750.0	—	17,405	275.0
Gravel	—	—	74.4	—	84.0	—	136.5	—	150.0	—	133.5	—	3,474	—
Stone														
Calcite	128.3	5,100 / 5,500 / 5,700	102.3	6,400	121.8	8,800	127.3	8,400	147.8	8,800	150.5	9,200	4,072	—
Dolomite	128.3	6,000	102.3	7,800	121.8	8,800	127.3	8,000	147.8	9,200	150.5	9,400	2,974	—
Coke	446.5	—	263.9	—	325.9	—	361.6	—	357.2	—	370.6	—	9,206	—
		Per cent.		Per cent.		Per cent.		Per cent.		Per cent.		Per cent.		Per cent.
Pig	737.4	—	735.7	—	757.7	—	706.8	—	715.7	—	712.3	—	18,101	—
Si	—	1.22	—	0.71	—	1.09	—	1.24	—	1.35	—	1.11	—	1.08
S	—	0.043	—	0.042	—	0.027	—	0.028	—	0.036	—	0.040	—	0.032
P	—	0.108	—	0.061	—	0.061	—	0.050	—	0.061	—	0.073	—	0.061
Mn	—	1.63	—	1.07	—	0.550	—	0.538	—	0.480	—	0.484	—	0.535
Ni	—	0.827	—	1.91	—	2.21	—	2.00	—	1.85	—	2.19	—	2.106
C	—	4.61	—	4.74	—	4.38	—	4.58	—	4.79	—	4.60	—	4.58
Cr		Approximately		0.90	—	—	—	—	—	—	—	—	—	—
Slag														
SiO_2	—	34.50	—	34.3	—	35.4	—	35.0	—	36.5	—	34.7	—	36.2
Al_2O_3	—	11.75	—	7.8	—	8.1	—	8.62	—	8.47	—	10.3	—	8.83
S	—	2.03	—	0.96	—	0.98	—	1.30	—	1.12	—	1.23	—	1.22
Blast														
Lb. per sq. in.	13.47	—	10.3	—	17.7	—	16.4	—	15.6	—	19.9	—	—	—
Cub. ft. per min.	42,228	—	34,428	—	41,008	—	41,280	—	39,716	—	37,122	—	37,950	—
Gas temp., deg. F.	1,075	—	1,367	—	1,272	—	1,157	—	1,304	—	1,334	—	1,280	—

iron, whether as hot metal or cold, was so little different from that normally expected from a furnace operating on 100 per cent. ore that no one paid any particular attention to it. When the furnace came "hot" and the sulphur below 0.04 per cent., the usual kish made its appearance in the cast house.

Scrap Classification

There are two separate and distinct classes of scrap for blast-furnace use:—

(1) *Iron Scrap*, emanating from iron castings, cast-iron borings, pig-iron, iron-ladle, mixer and runner scrap, ingot moulds and the high-carbon irons.

(2) *Steel Scrap*, emanating from machine-shop turnings and borings, crops, punchings, flashings, detinned billets, plate, pipe, structurals and any of the miscellaneous steel junk collected by the old-fashioned rag picker.

Because of their effects on blast-furnace practice and the general use for which the pig-iron is intended, the principal elements for immediate consideration are shown in the two composite mixtures (Table II). It is to be noted that

TABLE II.—*Elements in Two Classes of Scrap.*

Element.	Cast-iron scrap. Per cent.	Steel scrap. Per cent.
C	2.15 to 4.75	0.020 to 1.00
Si	0.30 to 3.25	0.002 to 0.50
Mn	0.40 to 0.85	0.250 to 2.00
S	0.03 to 0.250	0.015 to 0.065
P	0.060 to 0.800	0.010 to 0.105

while the two classes of scrap vary widely within themselves, there is just as great a difference between the two general classifications. As the percentage of either of the two classes of scrap is increased in the furnace burden, the effect on the metallurgy of the furnace becomes more marked. A radical change accompanies a switch from steel to cast-iron scrap in the burden; in fact, the effect may be more marked than the switch from a basic ore mixture to a foundry ore mixture. From analyses shown, it will be seen that the use of scrap in the blast furnace cannot be promiscuous.

Smelting versus Melting

The opinion has been rather general that the charging of scrap into the blast furnace constitutes a cupola operation. This is by no means true, as in the blast-furnace operation with a 100 per cent. scrap charge, no ore in the burden, it is essential for proper operation to carry a normal blast-furnace slag. Therefore this constitutes a smelting rather than a melting process.

Normally, about 85 per cent. of the sulphur entering the blast furnace enters with the coke. Cast-iron scrap may carry as much as 0.16 per cent. of its weight in sulphur, or more. The normal smelting operation will reduce this sulphur content to 0.025 per cent. or less in the pig-iron. As for the sulphur in the fuel (coke), from 90 to 98 per cent. will be eliminated with the slag.

It is general practice to reduce up to 1.25 per cent. by weight of silicon in basic pig-iron. The reduction of this silicon, as well as the removal of sulphur in the slag, requires a certain minimum of temperature. This means that 98.75 units of pig-iron must be raised to the minimum degree of superheat in order that 1.25 units of silicon may be reduced and the necessary minimum of sulphur removed.

A further indication of the intensity of the smelting operation is found in the carbon content of the pig-iron from 100 per cent. steel scrap. Although the scrap consisted of forging-quality steel, the carbons in the pig-iron ranged up to 4.74 per cent. and possibly higher. From personal experience with chromium, it is known that the excessive carbons shown are due largely, if not entirely, to the presence of that element.

The question as to the effect of 10 or 100 per cent. scrap in the blast-furnace charge cannot be answered in a few words. When discussing the effect of scrap on quality of pig-iron, unless any author can qualify his statement with the proviso that other things shall be equal, his commitment has little meaning. So many variables enter into the operation and production of a blast furnace that it becomes necessary to make corrections for inequalities; otherwise, irregularities are inevitable.

If it became imperative that the author answer the question: What effect does 10 per cent. or 100 per cent. scrap in the blast furnace have on pig-iron quality? the answer would be, in two words, no effect. One can no more attribute a particular quality in pig-iron to the use of scrap in the furnace burden than one can to the use of magnetite or hematite. Different qualities will be found in the pig-irons produced from Adirondack and Swedish ores, if for no other reason than that the Adirondack ores are titaniferous. Both, however, are magnetic.

As the percentage of steel scrap in the blast-furnace charge increases, the slag volume per ton of pig-iron decreases, thereby drying up the mix. The effect is analogous to that of gradually switching from a foundry mix to a basic mix. In such cases, where a furnace is set up on a siliceous mixture, the addition of steel scrap to the charge will be accompanied by a decrease in silicon content of the pig-iron. In such cases, the basic open-hearth operator will say that the addition of "scrap" to the blast-furnace charge leads to better steelmaking iron. When a furnace is set up for a fairly lean mixture, the addition of cast-iron scrap will cause a tendency toward a higher silicon pig (given the same sulphur). In such cases, the open-hearth man will claim that his results are not so good, even though his cost of pig-iron may be a little less.

When the open hearth is served with cast-iron scrap as a substitute for pig-iron, and with highly corroded steel scrap, all of which is to be used in the production of high-quality steels, the problem becomes difficult in the open hearth. By processing these scraps in the blast furnace, the sulphur is removed from the cast iron; the oxides, as such, are removed from the steel scrap, and the product delivered to the open hearth as a "quality" raw material.

The effect that any pig-iron has on a steelmaking mix is not especially due to the use of a particular raw material in the blast furnace, but is, rather, a matter of balance. The percentage of silicon in the pig-iron must vary with the percentage of pig-iron in the open-hearth charge. When lowering the silicon content as a result of additions of steel scrap to the blast-furnace charge, this naturally speeds up the open hearth, providing a proper temperature has been maintained in the hot metal.

Economics and Quality

The economy of any blast-furnace operation is different from that of every other blast-furnace operation. Of primary importance in the use of scrap is the question of economy, and the strategic position of a furnace in relation to its sources of raw materials will probably be reflected in the quality of its product. The scope of this subject is so broad that it can only be touched upon briefly with examples:

(1) In order to work a heat of steel in the open hearth, it is necessary that the bath contain a certain minimum percentage of carbon. Where a plant has the facilities to do so, it can purchase rusty steel turnings, impregnate them with carbon and silicon in the blast furnace and deliver the product to the open hearth as hot metal. The advantage to be gained by such practice will be determined by the relative costs of melting in the open hearth and smelting in the blast furnace.

(2) Cast-iron scrap frequently is used as a substitute for pig-iron in the open hearth. Such scrap can be desulphurised in the blast furnace and delivered to the open hearth as hot metal.

(3) Steel scrap of known source may be impregnated with carbon and silicon in the blast furnace, Bessemerised into high-quality steel, or duplexed through the open hearth into special steels.

(4) When fuel prices become the dominant factor in the matter of costs, the use of iron or steel scrap in the blast furnace becomes a matter of immediate importance, as the fuel ratio may be reduced from 40 to possibly 50 per cent.

(5) Desirability in the use of scrap changes daily, the principal determining factors being relative costs of iron in the form of iron ore, steel, cast-iron scrap; the effect of coke prices on pig-iron costs, the need for production, spread between costs and selling prices, and the uses for which the pig-iron is intended.

The author believes the following statements to be as axiomatic with scrap in the blast-furnace burden as when operating with ore only, and that furnacemen may feel safe in accepting them literally; also, that open-hearth operators should consider the merits of such points in so far as such knowledge may assist in diagnosing certain difficulties peculiar to their operations:

(6) Other things being equal: (*a*) as the temperature of the blast-furnace hearth increases, the carbon content of the pig-iron and the ratio of graphitic to combined carbon will increase; (*b*) increase in silicon content will be accompanied by a decrease in total carbon and an increase in the ratio of graphitic to combined carbon.

(7) Silicon and sulphur are diametrically opposite in their effects upon carbon in pig-iron, silicon favouring graphitisation, while sulphur causes carbon to enter the combined form.

(8) Slow cooling favours graphitisation.

(9) The silicon content of the pig-iron does not vary uniformly with the hearth temperature when the ratio of silica to bases in the slag-forming material varies, and, the silicon will not vary uniformly with temperature when the volume of slag-forming material varies.

Conclusion

There appears to be no reason fundamental in nature for any difference in the qualities of pig-irons produced from ore and from scrap. When differences do occur, they are complementary with the nature of the materials involved, and such variables are inherent in ore mixtures just as in mixtures that include scrap.

When residual elements such as copper, nickel or chromium appear in pig-iron, cognisance should be taken of such occurrence and provision made for their digestion in the open hearth.

Before scrap additions are made to the blast-furnace burden, the economics of the proposed practice and the use for which the pig-iron is intended should be given fullest consideration.

Notes from Experience

First consideration had to be given to the necessity of producing an iron that could be used in the production of special steels—hence the liberal slag volume.

Fuel requirements were judged through a combination of calculation and deduction. The trend in fuel consumption accompanying increasing percentages of steel turnings was known.

It was quickly learned that as the percentages of scrap increased beyond normal there was an accompanying decrease in top temperature. With 100 per cent. steel scrap the stock line was dropped about 12 ft. below normal, otherwise the top temperature would have been below

(*Concluded on page* 318.)

Factors in the Production of Sand Castings in High Duty Iron*

By J. KING

This Paper deals with some of the factors influencing the production of sound castings in Meehanite, for sound castings are the primary aim of every foundryman. Soundness is governed by a number of factors, including metal composition, melting conditions, casting temperature, sand control, gating, etc. To discuss all, or even several factors, would entail too much time and space. In the main the author deals in detail with the results of personal experience.

Sand Control

This plays a very important part in the production of castings, and is responsible for many wasters, usually through lack of permeability. Permeability can be increased by judicious venting, but few moulders seem able to use a vent wire properly, and therefore sand should, where possible, be graded and mixed to give the desired permeability without resort to the vent wire. This can be proved by experimenting with sand moulds using sands of varying permeability. Low refractoriness in sands is responsible for surface defects and machining troubles due to sand adhering or fusing to the surface of the metal. This increases machining difficulties and fettling costs rather than being a cause of unsoundness.

Control of moisture content is also essential in order to avoid blow-holes and loss of permeability. It will also possibly affect the structure of the casting, as steam and gases generated by the contact of hot metal with the water in sand pass through the metal. Excess moisture also causes chilled edges, etc. Care should be taken in ramming the mould, which is generally done more efficiently by machine. The author's firm uses a fusion test of sand—believing it to be essential for heavy work, especially for tops of moulds for large castings. For instance, if a riser blows air (commonly called "drawing" air in the foundry) it gives an idea as to the heat to which the top face of the mould is subjected as the hot metal rises to it, especially if the top has facing strips on it.

One job to which it seems desirable to refer is a casting made off the old one used as the pattern. It was a 100-ton press casting, a combination of two cylinders and table, weighing 11 tons 10 cwt. Sand control played a big part in making this a successful job, which is illustrated in Figs. 1 to 3. The casting used as a pattern was over thirty years old, and was analysed to discover its composition. Samples were taken which gave a tensile test of less than 9 tons per sq. in., and the analysis was that of a very poor iron. The new casting was made in an ordinary grade of Meehanite, which gave a tensile of 18 tons per sq. in.

For successful results, the sand requirements for cores are similar to those already mentioned, and sand testing and control contribute greatly towards this end. The author recognises the progress made in sand research in this country. To-day executives can confidently operate their foundries with every property in sand practice under direct control. This is as it should be, since the mould for containing the hot metal is just as important as the metal itself in the production of quality castings. However, it might be as well for all to remember at all times that just testing sands, or trying to make synthetic sands, does not make castings. Foundrymen must in all cases employ judgment as to results from sand tests, and especially is this the case in the manufacture of synthetic sand.

Interpretation Needed

Hasty judgment in connection with either of these procedures leads to negative results. Sound knowledge, coupled with proper interpretation, is of vast importance to anyone interested in the proper selection and use of sands in the foundry. It now appears clear that foundrymen can look forward with confidence to great improvements in sand practice in the near future. Rapid changes are developing in the mechanical treatment, more use is being made of clays for re-bonding, and even cement is also used. With these developments the industry should soon be in a position to select, blend, and use sands located anywhere in the country with good success, for iron, steel, or non-ferrous castings. Sand testing and control in conjunction with the proper blending makes possible the use of local materials in place of moulding sands located perhaps scores of miles away.

Operations of this sort develop economies of considerable value to foundrymen. Selection of sands for use in the foundry is based primarily on needs as related to the range in size of the castings to be made. It is now a simple matter to select approved moulding and core sands with the assurance that in use they will yield satisfactory results. Founders can if they wish submit specifications to the sand suppliers, and they in turn will, with reasonable accuracy, supply the sand in accordance with the specification. However, some foundries are still ordering by trade names and not by specification.

Here is an initial opportunity for simplicity, for an effort should be made to have the least number of sands possible in the foundry. This procedure avoids complications. For example, if a coarse sand with high permeability for heavy work be needed, an endeavour should be made to use that type of sand exclusively for heavy work. At no time should a very fine sand be mixed with it, because in doing so the advantages of open grain and high permeability are lost through small grains and interstical congestion in the fine sand.

The author's practice consists in the use of one type of sand for light and medium work, and another for heavy tops, etc. It is quite customary to find jobbing foundries operating with a great variety of moulding sands of different grain-size, clay content and permeability. It is also quite usual in jobbing foundries to find moulders free to use their own judgment in mixing and blending any of the sands in the shop.

The mixing and blending of sands with widely different physical properties is wrong, and runs contrary to established knowledge of better sand control. In making specific recommendations for sand practice in foundries, one should always take into consideration the shop conditions under which the sands will be used.

It is not sound to suggest the use of any sand unless the methods of operation in the foundry are known. Then only can one constructive advice be given on the type of sand

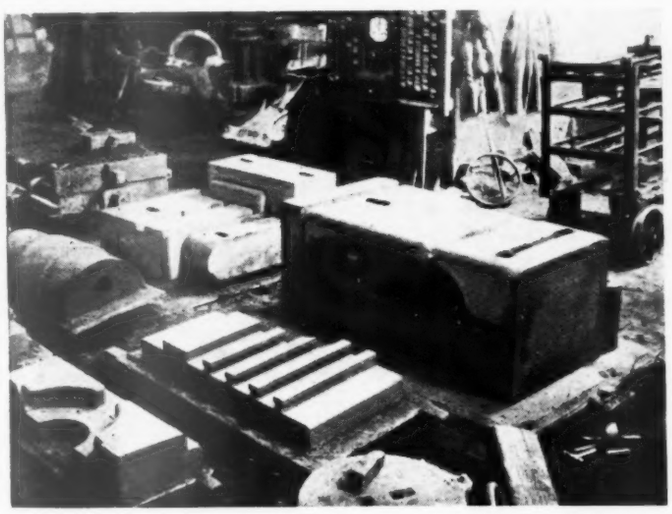


FIG. 1.—SOME OF THE CORES USED FOR THE MAKING OF A 10-TON CASTING USING A DISCARDED CASTING AS A PATTERN.

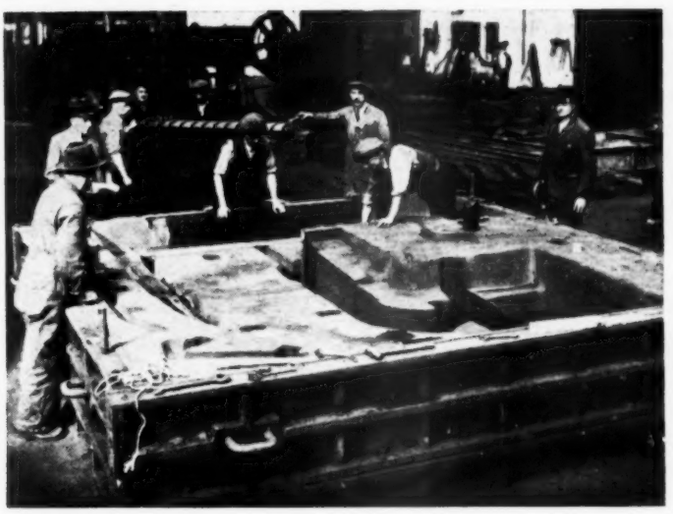


FIG. 2.—CORES BEING ASSEMBLED IN THE MOULD.

* A paper read before the East Anglian section of the Institute of British Foundrymen, Mr. H. H. Shepherd presiding.

best suited to that particular practice. For example, one foundry may use a continuous sand handling system, another may use muller mixing operations, and a third one employs machines of the Royer type or sand cutter.

All mechanical treatments are good, but they produce widely different results. This must be borne in mind when making definite recommendations. Simplicity has been strongly emphasised throughout this reference, both from the standpoint of selection and use, as well as testing and control of sands.

Runners and Risers

In leaving this subject it seems clear that by careful selection to begin with, followed by suitable preparation for the work in hand and then applying commonsense methods of testing and control, foundrymen can accomplish much in the manufacture of castings. In most foundries engaged in making a miscellaneous line of castings, and this applies to practically all Meehanite foundries, the question of risers, their size, shape and location is one that calls for profound attention and consideration—more than is given in a good many cases. Considering the variety of castings as wide as in most foundries known to the author, the risers used are few in number. It is true the author's firm has perhaps a little better chance to develop their shop practice because most of their work is for use in their own machine shops, and for their own line of machines of various types, but there is no chance of anything being accepted by the Inspection Department, unless it is entirely satisfactory in material and in workmanship.

The author was convinced that in many cases some foundries would be rather glad of a chance to take for their use some of the castings his firm scrap as not being up to standard. However successful or otherwise the firm may be, or have been, in succeeding without extensive use of risers, it is not his purpose to say whether risers should or should not be used in other shops as they are now being used. It is possible this practice is correct, and, while it may be expensive in that it reduces the yield in saleable castings per ton of metal melted, yet it may be a measure of insurance against the loss of a casting for which the customer may be in quite a hurry. Then, again, risering may do more harm than good. An interesting Paper given on runners and risers, to which reference is strongly commended, was given to the Scottish Branch by J. Longden (Paper No. 624, Volume XXX, 1936-1937).

Defective Castings

Everybody has heard that some foundries have no scrap, whilst others have 5 to 10 per cent. The Author has his own opinion of the so-called 100 per cent. no-scrap foundry, so he will try to help the alleged 5 to 10 per cent. scrap category. Three basic factors must be considered in this connection: (1) Mental attitude towards defectives; (2) management responsibility; and (3) nature and conditions of work.

Mental Attitude.—In considering the basic conditions responsible for defective work, it is evident that the main factor is that defective castings are tolerated in the foundry. In other words, the mental attitude of management and staff is to expect defective castings. They are accepted as a matter of course, and, provided that they are kept down to what is considered a normal working range no great attention is paid to the matter. It is frequently argued that the foundry loses nothing by defective work since this is covered by the estimated loss included in the price.

This is an example of the mental attitude which is responsible for defectives.

Management Responsibility.—The scrap problem is essentially a management problem, in fact, it may be stated as a general rule that the percentage of defective work is inversely proportional to the attention given by the foundry management to this matter. Management is directly concerned with obtaining the maximum operating efficiency, and elimination of defectives is as closely related to efficiency as in production capacity.

Nature and Conditions of Work.—Defective castings may be classified into two main divisions: (1) Defective materials, and (2) defective workmanship. Both of these conditions are traceable to the management whose duties include: (1) Suitable places for men to work; (2) supply of the correct working materials for the men; and (3) education and supervision of men in correct methods of working. Owing to the nature of foundry work, these duties become of vital importance in foundry management. In the days of apprenticeship a casting made just before leaving off for the day, and known to be a waster, would cause a restless night, but by experience it has been found that worry will not remove the cause. An inquest on the defective will prevent a repetition. No replacement should be made until the cause of the trouble is ascertained. Mr. Tibbenham, in his presidential address, referred to defective castings. Since then, the Author has thought that

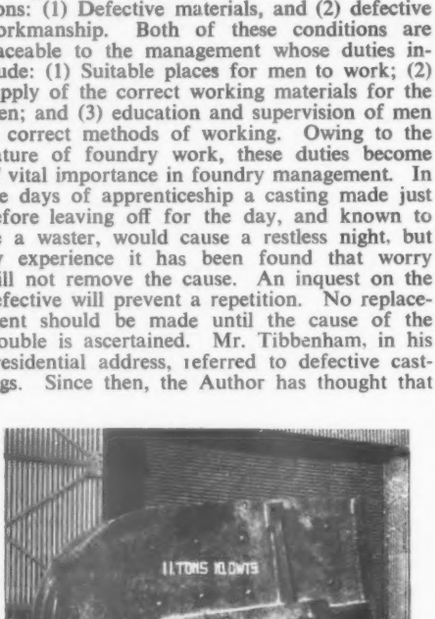


FIG. 3.—THE FINISHED CASTING.

a Paper on the subject would be most opportune. It is hard to obtain 100 per cent. good castings, but an effort is made to get as near to it as possible, and tackling this defective problem objectively will help the foundry to reach this goal.

Defectives in the Machine Shop

A large proportion of the castings found defective in the machine shop are due to the lack of collaboration between designer and machine shop. In the production of castings there is involved the work of the designer, the patternmaker, the foundryman, and the machine shop engineer. Much of the difficulty of collaboration between these departments is due to the lack of appreciation of the difficulties involved in other work and in particular to the fact that each talks in a different technical language.

The collaboration should be divided into three. First, choice of materials—information available to the designer for the selection of the material best suited to the service involved. Secondly, collaboration between designer and foundry to reduce moulding and metallurgical problems. Thirdly, collaboration between foundry and machine shop to facilitate machining operations.

Each of the subjects touched upon are such that a Paper could be given on each, and a very interesting Paper, too. These subjects were selected from experience in changing from ordinary cast iron to Meehanite. In conclusion, the author would like to thank the management of Ransomes & Rapier, Limited, also the International Meehanite Metal Corporation, for permission to give this Paper.

DISCUSSION

MR. J. L. FRANCIS congratulated the author on his practical Paper, and put the following questions:—(1) Are denseners employed? and (2) is any rod feeding practised? Commenting on the standardised pouring basins, runners and gates, moulded from proper patterns, he said how often one saw every care taken with moulds and cores whilst ingates were cut at the moulder's discretion and any odd piece of wood employed to form a downgate. This haphazard method tended towards a surface made up of disturbed sand grains which came away with the metal stream. All the metal entering a mould must pass through the runners and, therefore, they should have at least as much care and attention as the mould itself. Gates and runners supplied as part of the pattern ensured the same undisturbed sand surface as mould and cores, and made a serious contribution towards soundness in castings.

MR. GEO. HALL thanked Mr. King for his foundryman's lecture to foundrymen. He asked whether the pencil runners used were invariably the diameter of a pencil and more or less used according to the size and weight of the casting. As Mr. King employed no horse manure in his sand, what did he use in place of it Mr. Hall had used sawdust successfully, but it had to be from wood containing a minimum of oil, as otherwise difficulty was experienced in the blacking of the sand surfaces.

MR. D. CARRICK inquired as to the time taken in pouring moulds, and asked if Mr. King made use of any means of calculating the size of gates and runners relative to the weight and size of the casting.

MR. L. E. SLATER asked if Mr. King made fluidity tests, and said also that where sand burnt on it was more often due to unsuitable sand than the fault of the runner. He also asked whether the author had tried feeding from the side and bottom of, for example, a flywheel with clutch plate, the latter cast in the bottom.

MR. H. H. SHEPHERD said that Meehanite metal had the right to rank as high as any other metallurgical development of recent years. The lecturer had given instances of Meehanite replacing castings of malleable cast iron. Such high grade irons, however, had not been successful in making the replacement in all cases, and service equipment subject to blast effect was a case in point. A beneficial feature of the use of strainer cores was their prevention of air sucking in with the metal. Finally he proposed a hearty vote of thanks to Mr. King for his excellent practical talk.

Author's Reply

MR. KING, in replying, expressed appreciation for the way in which his Paper had been received. Denseners were used round the outside of some castings, but not internally. Rod feeding was used, but by standardised methods of running and risering as explained, he had cut down this method of feeding by 20 per cent.

With regard to pencil runners, these were approximately the diameter of a pencil, and could only be applied for top running. In place of manure he employed cocoanut fibre, cut about 1 in. long. Mr. Francis had used spent hops as obtained from breweries with success.

In reply to Mr. Carrick, MR. KING said that sizes of down gates and runners were fixed empirically, and from experience accumulated by recording pouring times for various castings over a period.

(*Concluded on page* 320.)

Third Report of the Oxygen Sub-Committee

(*Continued from page* 295.)

In our last issue we reproduced the General Summary of the Third Report of the Oxygen Sub-Committee, a subsidiary of the Committee on the Heterogeneity of Steel Ingots, by Dr. T. Swinden, Chairman of the Sub-Committee, together with a Paper on recent developments on the determination of oxide inclusions in pig-iron by the modified aqueous iodine method, by Mr. E. Taylor-Austin, of the B.C.I.R.A. This Report was submitted as Paper No. 5/941 of the Committee on the Heterogeneity of Steel Ingots, to the Annual Meeting of the Iron and Steel Institute held in London last week. Two further contributions to the Report, emanating from the B.C.I.R.A., viz., "The Determination of Total Oxygen in Pig-Iron by the Aluminium Reduction Method," also by Mr. E. Taylor-Austin, and "The Present Position of the Determination of Oxide Inclusions in Pig-iron and Cast Iron," by Mr. J. G. Pearce, are reproduced below.

THE DETERMINATION OF TOTAL OXYGEN IN PIG-IRON BY THE ALUMINIUM REDUCTION METHOD

By E. TAYLOR-AUSTIN, F.I.C. (BRITISH CAST IRON RESEARCH ASSOCIATION, BIRMINGHAM).

The method adopted for this series of experiments was that described by Gray and Sanders in the Second Report of the Oxygen Sub-Committee.* A thorough investigation of the application of this process to the determination of total oxygen in pig-iron was made and it was found necessary to modify the original procedure in order to avoid interference from silicon.

The following method has been successfully applied to a series of grey pig-irons, and a comparison of the results obtained with those by other processes is given in Table I of the earlier article.

Modified Aluminium Reduction Method

Apparatus.—This is as described by Gray and Sanders* except that the silica combustion tube of the main furnace is heated by a winding of Kanthal resistance wire instead of Silit-rod elements.

Preparation of Samples.—Samples should weigh between 7 and 10 g. and should be in the form of strips not greater than $\frac{1}{16}$ in. thick taken from the centre of a complete cross-section of the pig.

Determination of the "Blank."—The "blank" on the pure aluminium sheet used is determined by fusing 14 g. of the material together with 0.20 g. of a steel of low oxygen content exactly as described by Gray and Sanders. In the author's experiments a blank value of 0.0008 g. was obtained.

Procedure.—Fuse 7 to 10 g. of sample with 14 g. of pure aluminium sheet at 1,100 deg. C. exactly as described in the original process. At the conclusion of the heat withdraw the boat from the cold tube and transfer the alloy to a 1,500-ml. tall-form beaker. Add 5 g. each of citric and tartaric acids, followed by 200 ml. of nitric acid (sp. gr. 1.20). Warm gently until the citric and tartaric acids have dissolved, and add 60 ml. of concentrated hydrochloric acid, carefully, in small amounts. When the violent reaction subsides, heat to boiling, and keep hot until solution is complete (about 30 min.). Cool somewhat, add 10 g. of ammonium persulphate and boil gently for 1 hr. Dilute with an equal volume of hot water, boil and filter on an ashless paper-pulp pad.

Wash the residue with hot 5 per cent. hydrochloric acid and hot water. Transfer the precipitate and pad to a 300-ml. "carbon dioxide" flask, add 120 ml. of a 5 per cent. sodium carbonate, 10 per cent. sodium citrate solution and stir mechanically for 1 hr. at 80 deg. C., as described in the procedure for the aqueous iodine method.

Filter the solution through a 4.25-cm. Whatman No. 42 filter paper contained in a small Büchner funnel; wash well with hot water, followed by hot 5 per cent. hydrochloric acid and finally with hot water. Ignite the residue to constant weight in a platinum crucible. Remove any traces of silica remaining in the precipitate by volatilisation with hydrofluoric acid in the presence of sulphuric acid in the usual manner. The residue so obtained should be pure alumina, and the weight after deduction of the blank is used for the calculation of the oxygen content of the material under examination.

Development of the Modified Procedure

At the beginning of 1940 the necessary apparatus and equipment were installed and experiments were begun. After certain initial difficulties in technique had been overcome, results were obtained which were in close agreement with those of Gray and Sanders working on joint samples of pig-iron.

After these preliminary tests the method was applied to the series of pig-irons already examined by the modified aqueous iodine method, and it was found that in all but a few cases good agreement was obtained between the total oxygen results by the two processes. Where agreement was not obtained, the results by the aluminium reduction method were of a considerably lower order than those by the aqueous iodine process.

Further investigation of these discrepancies revealed the fact that the silica figures obtained by the aqueous iodine method were high for reasons already given.† Redeterminations by the iodine process, suitably modified, on samples which had previously yielded checking results by both the methods under review revealed the fact that some of these silica figures were also in error.

This led to a thorough examination of the application of the original Gray and Sanders procedure to pig-iron samples, and it was found that this process sometimes yielded results which were greatly in excess of those recorded by the aqueous iodine method. It was subsequently revealed that this error was caused by the presence of excessive amounts of silica in the final ignited residue obtained after solution of the alloy in mineral acids; the removal of this silica by volatilisation with hydrofluoric acid made no appreciable difference to the amount of alumina found by chemical analysis of the residue. Further experiments showed that the extent of this error increased as the silicon contents of the original pig-irons became greater.

The author was therefore of the opinion that the presence of this silica was due to hydrolysis during the solution of the melt in acid and that this silicic acid adsorbed aluminium salts from the solution, thus causing excessive amounts of alumina in the final residue.

Accordingly the sodium carbonate-citrate treatment, already used in the aqueous iodine method, was applied to unignited residues from the aluminium reduction method. It was found that this procedure successfully removed the hydrolysed silicic acid, and the results for total oxygen fell considerably. Further, the final figures were in good agreement with those obtained by the latest aqueous iodine process.

The aluminium reduction method was therefore modified to incorporate this treatment, and in this latter form was applied to the series of pig-irons already mentioned. The results obtained for total oxygen by both procedures were now found to be in excellent agreement, and no further discrepancies have so far arisen.

The application of the aluminium reduction method to pig-iron is, at the present time, limited somewhat by the difficulty of obtaining test-pieces from samples of white and other hard irons. This difficulty does not arise if samples can be cut with a hack-saw, but if it is necessary to use a carborundum wheel to obtain specimens, considerable oxidation appears to take place on the surfaces, and high results are recorded. Attempts to use drillings or crushings enclosed in an aluminium envelope have so far failed, owing to the difficulty of removing trapped oxygen by passing hydrogen through the furnace. This difficulty would probably not arise if fusion were carried out *in vacuo* instead of in hydrogen, but the author has had no experience of the former procedure, although it has been examined by other workers. The problem of obtaining suitable samples from hard materials is receiving further attention.

Conclusions

The experimental work so far carried out has led to the following conclusions:—

(1) The modification introduced successfully obviates any interference arising from the presence of silicon in the original material.

(2) The modified aluminium reduction method can be applied to the determination of the total oxygen content of pig-irons generally, provided that a suitable sample can be obtained.

THE PRESENT POSITION OF THE DETERMINATION OF OXIDE INCLUSIONS IN PIG-IRON AND CAST IRON.

BY J. G. PEARCE, M.Sc., F.INST.P., M.I.MECH.E., M.I.E.E. (BRITISH CAST IRON RESEARCH ASSOCIATION, BIRMINGHAM).

Inclusions in cast iron and pig-iron are of as much interest metallurgically as are those in steels, but not entirely for the same reasons. Present consideration is confined to solid and to inherent, as distinct from foreign, particles, although a sharp distinction between them is difficult to draw.

Knowledge of the amount, nature, size and mode of distribution of these particles may throw light on many still obscure points, foremost among which is whether small particles of silica or alumina or complexes into which they enter are in any way associated with the precipitation of graphite, and some investigators have not hesitated to postulate the nucleating effect of sub-microscopic particles of iron silicate. Furthermore, it is necessary to find out whether they offer any explanation of other points, such as the so-called hereditary properties of pig-iron (persistence of properties through subsequent remelting), and the difference between hot- and cold-blast or between coke and charcoal pig-irons. Do they throw any light on why pig-irons of different origins, but similar chemical analyses, behave differently in practice during the manufacture of cast or wrought steel or iron? Do they change as between ordinary and desulphurised pig-irons, between pig-irons and their remelted forms, refined pig-irons and cast steels and irons, or be-

* Eighth Report on the Heterogeneity of Steel Ingots, pp. 103–108. Iron and Steel Institute, 1939, Special Report No. 25.

† See previous article appearing in our last issue (p. 295).

tween coarse-graphite and supercooled-graphite irons? Does superheating or agitating the melt have any influence on them? Whether such particles ultimately prove to have any such effects or not, it is necessary to find out, so that unprofitable speculation may be avoided.

When the British Cast Iron Research Association began to study this subject in conjunction with the Oxygen Sub-Committee, the alcoholic iodine method was naturally adopted, as it permits the quantity of the individual oxides to be determined, although the vacuum fusion method is now acknowledged as unrivalled for the determination of total oxygen. No special difficulty was anticipated, but after exhaustive trial the alcoholic iodine method was abandoned for pig and cast irons on account of interference set up by phosphorus (*i.e.*, the phosphide compound is only partially attacked by the solvent and hence some is left in the residue), as described in the Second Report.[1] The chlorine method was then tried and also abandoned for pig and cast irons, this time on account of interference set up by manganese.[2] The older acid methods were re-examined, but work with both strong and dilute acids indicated that these procedures have a very limited application to pig and cast iron. With dilute acids, solution of the metal occupies considerable time, and such large amounts of silicic acid separate, that filtration of the final residue is very difficult; with strong acids, the silica results are considerably lower than those given by aqueous iodine, and it would therefore appear that these solvents decompose some of the silicates present in the residue. Results for alumina are in good agreement with those by aqueous iodine. It was therefore concluded that, as far as pig and cast iron are concerned, only alumina figures are obtainable from acid methods, which therefore have only a limited application to these materials.

A method based on the use of aqueous iodine as a solvent was then evolved and adopted, and was described in the Second Report[3] as the foundation of a reliable method, although various problems remained to be solved. In the meantime, the publication in the same Report of the aluminium reduction method by Gray and Sanders[4] led to the trial of this in order to provide a total-oxygen check on the aqueous iodine by a method less expensive than vacuum fusion. Very little adaptation was needed, and the aqueous iodine and aluminium reduction methods as now used for pig and cast iron are described in the present Report,[5] with some results from both methods, and from vacuum fusion where these figures are available. The accord is very satisfactory, and it is felt that the two methods are now in reasonably final form.

The acquisition of the necessary technique enabled the methods to be applied to the examination of a series of representative British pig-irons, of which thirty, supplied by the Blast-Furnace Committee of the British Iron and Steel Federation, were on the 1940 programme. To date, about 45 have been examined by both methods, although the analysis of the results is not yet complete. Furthermore, very little has been done on cast irons. The preliminary percentage figures indicate the following ranges for the various oxides in the above pig-irons:—

	Per cent.
Silica (SiO_2)	0.003 to 0.020
Ferrous oxide (FeO) ..	0.009 „ 0.045
Manganous oxide (MnO) ..	Nil „ 0.002
Alumina (Al_2O_3)	Nil „ 0.008
Total oxides	0.017 „ 0.060
Total oxygen	0.005 „ 0.020

The oxides as a whole are similar to those found in steel, but not necessarily of the same order. It must not be assumed that they are present as simple oxides. They are expressed in this form because the residue representing inclusions separated from the metal has to be ignited or subjected to chemical oxidation to get rid of graphite. They are almost certainly present in a more complex form, and thermodynamic considerations suggest that inclusions to be expected in pig and cast iron, apart from sulphides, are alumina, silicates of iron and manganese and, under certain conditions, free FeO, MnO, or SiO_2. The calculation of the FeO and MnO content of the residue to silicates, allowing for the FeO in solution, checks well with the determined values of SiO_2 in the residue, but this is based on equilibrium conditions.

As the work on chemical methods progressed, two points became evident. First, the amount of inclusions present proved to be very small, compared, for example, with the sulphides present. (Sulphides are decomposed in the modified aqueous iodine procedure, and hence do not appear in the final residue. Sulphur is determined by direct chemical analysis, although this does not show any division between iron and manganese. Sulphides as such can be separated from iron by electrolytic methods, although little work has so far been done on such methods. But it may be noted that just as efforts can be made microscopically to see what is determined by chemical methods, so, chemically, efforts can be made to separate what is visible microscopically and quantitative figures obtained.) Indeed, the oxide inclusions in pig-iron appear to be less than are found in many steels, and form a slender basis on which to erect a superstructure of theory. Secondly, there appeared to be a lack of relation between inclusions chemically determined and those visible microscopically.

The laboratories of the British Cast Iron Research Association have examined many thousands of samples of pig and cast iron in all their forms, and the author initiated a more systematic examination from the point of view of inclusions, primarily to see whether any light would be thrown on the way in which the chemically determined oxides were actually present. The results of this examination are now available,[6] and, even acknowledging that the microscope can give no evidence of particles in solution or of submicroscopic size, the results are startling.

Apart from sulphides, the inclusions visible in pig and cast iron are due to titanium, and these are so common that their presence must be regarded as normal. Incidentally, experience does not suggest that inclusions microscopically visible in pig-iron differ materially in quantity or type from those in cast iron. Most striking of all, however, is the complete absence of any microscopic evidence of the presence in ordinary commercial materials of oxides or silicates of iron, manganese or aluminium.

Various suggestions can be put forward to assist in resolving the apparent contradiction between the chemical and microscopic methods of approach, but the author does not propose at present to go beyond recording his conviction that the results obtained by both methods, as far as they go, are correct, and that the resolution of the contradiction is facilitated by a clear statement and is bound to lead to further advance. The work is being continued from both aspects.

That the contradiction is more apparent than real is shown by the fact that, excluding sulphides for the reason mentioned above, the principal visible inclusions are those of titanium. Omitting the latest treatment in the aqueous iodine method, these can be frequently found in the chemical residue as TiO_2, but as there is ground for belief that they are actually present in the metal as carbide or cyano-nitride, they are not considered among the oxide inclusions mentioned above. The absence of the oxide as such is supported by chemical evidence. Chromium occasionally appears as Cr_2O_3 in the residue, but the inclusions in alloy pig and cast irons have not yet been dealt with. So far as FeO, SiO_2, MnO and Al_2O_3 are concerned, the form in which they exist may well prove too small in quantity for microscopic identification.

The problem of nomenclature has been dealt with (Morrogh, *loc. cit.*). The use of the terms "metallic" and "non-metallic" can only be defended by special interpretations of them. Certain constituents of the metal other than ferrite, pearlite and cementite, particularly graphite and phosphide, are non-metallic, while certain carbides, *e.g.*, titanium carbide, may partake of the nature of inclusions. It is also desirable to distinguish between inherent inclusions and foreign inclusions due to the pick-up of material from furnace linings, slags or mould material, heterogeneous in their distribution and influenced by operating technique. As there are likely to be similarities between them, the foreign inclusions of one melt may become the inherent inclusions of subsequent melts.

As far as pig-iron samples are concerned, an adequate number is available for further work, but samples would be appreciated of both pig-irons and cast or wrought material made therefrom where unexpected behaviour has been encountered in practice apparently due to the raw materials used, and not explained by chemical analysis or other factors.

REFERENCES

[1] Taylor-Austin, Second Report of the Oxygen Sub-Committee, Iron and Steel Institute, 1939, Special Report No. 25, p. 159.
[2] Colbeck, Craven and Murray, Second Report of the Oxygen Sub-Committee, Iron and Steel Institute, 1939, Special Report No. 25, p. 109.
[3] Taylor-Austin, Second Report of the Oxygen Sub-Committee, Iron and Steel Institute, 1939, Special Report No. 25, p. 121.
[4] Gray and Sanders, Second Report of the Oxygen Sub-Committee, Iron and Steel Institute, 1939, Special Report No. 25, p. 103.
[5] See the two papers by Taylor-Austin, already published.
[6] Morrogh, "The Metallography of Inclusions in Cast Irons and Pig Irons." Iron and Steel Institute, 1941.

Scrap in the Blast-Furnace Burden

(*Continued from page* 314.)

the dew point. Lowering of the stock line would, almost certainly, have been forced in any event, because of the blast pressure.

Furnace symptoms indicated an extensive cooling of the furnace, well down in the inwall. Daily consumption of fuel was not a clear indication of daily production, as the volume of casts varied widely.

The daily log shows no undue blast pressure until the swing-over from scrap to ore. Because of the cooled condition of the furnace, a few blanks of coke were charged, followed by a conservative allowance of fuel for the normal ore charge and the furnace filled to regular stock line. Shortly thereafter, the pressure suddenly rose to the point where no gas appeared to be passing through the furnace. The tuyeres continued bright but showed no life.

The diagnosis for the high pressure condition was that the weight of the ore burden caused several of the large blankets of turnings to collapse when hot, thereby sealing the furnace. At this point, a steam blower was put on the furnace with instructions to turn as slowly as possible, giving about 5 to 8 lbs. pressure. In about 3 hrs. the pressure relaxed without a slip and the blast increased rapidly to normal. It may be assumed that the steel scrap absorbed carbon before melting, thereby lowering its melting point, after which the melt ran ahead of the coke, followed by drop in pressure.

In further operations with 100 per cent. scrap it is the author's suggestion that when switching from scrap to ore, the lowest stock line permitted by top temperature be maintained until it is reasonably certain that the last charge of steel turnings has been digested, after which a reasonable charge of fuel should be made for the purpose of preheating, and the furnace should be filled to the normal stock line.

Automatic Firing and Control for Foundry Stoves

By JAS. TIMBRELL

The idea of forcing hot air into core and mould drying stoves, not so many years ago, was generally welcomed by foundry executives as a marked improvement over the natural draft fireboxes then in use. Where these units were added to existing stoves, improved efficiency and economy in fuel were obtained, with a smaller firebox area; also a much more quickly reached drying temperature and a correspondingly faster evaporating and circulating rate inside the stove.

Fig. 1 shows an efficient type of forced hot air, hand-fired unit, added to an existing stove which had run for several years with uncertain results on natural draft. The sketch shows the main features that apply. The air pressure is provided by a fan A placed on or near the unit, whilst damper B controls the amount of air delivered into the firebox front. The width of the opening of the ash pit doors D controls the admission of pressure under the firebars, and the volume passed over the hot fire is controlled by the stoking doors E. Auxiliary air slides H allow extra air to be circulated into the top of the firebox arch. I is a mica-covered window to allow the condition of the fire to be seen.

The stoking, damper settings and general control of the drying results are entirely within the judgment and experience of the stoker, who, in many cases, has several stoves to superintend and control as regards clinkering, feeding and general observation. Where pyrometer recording charts are coupled into the stoves, any over stoking or neglect is shown by "peaks" or "clips" in the line, as the case may be; as regular a line as is possible is the aim, which means firing incorporating "bit and often," as recommended by the makers.

Mainly, with hand stoking where the fireman has a "round" to do, the tendency is to build up the firebox to capacity, and, till this is burned up, the drop in temperature is noticed on the chart, with a higher level than is sometimes desirable afterwards, and the possibility of over-dried moulds or cores immediately in front of the inlet flues inside the stove. Dampers and doors are manipulated to prevent these minor drawbacks.

Automatic Firing

Fig. 2 shows the main features of an automatically fired and controlled unit which, on observed and recorded results, removed most of the disadvantages previously mentioned. The hopper A is filled up daily. This may be situated at any reasonable point with respect to the bulk fuel supply. The feed worm B propels the fuel along into and upwards from the centre of the retort area C. A three-speed gearbox, designed to allow any rate of combustion and temperature within the range required, drives the fan and worm feed. The fan D has its main inlet into the area E, surrounding and keeping cool the tuyeres F, which are arranged round the top of the combustion space.

The tuyere outlet slots introduce forced air into the fire evenly; an amount of air is also put into the centre of the fire through the worm feed tube at G. Combustion is always on top of the fuel, and a layer of bright, free-burning fire is the result, for any ash or clinker formed is gradually pushed over and into the area H outside the tuyeres. The slow, continuous fuel feed keeps the fire at one level and in regular heat, the size of which is according to the rate of supply.

The fan output is controlled at the intake. The indicator flap J shows the amount of air delivered into the air space round the retort and tuyere area; incidentally, this item prevents any hot gases finding their way back into the fan when the motor is stopped. In the not-impossible event of a piece of scrap finding its way into the fuel hopper and thence into the worm feed tube, an easily renewed shear pin is fitted at the gearbox end; the removable cover K allows easy access to the place where the obstruction must take place; this can then be removed.

A red light or bell is wired into contacts, and

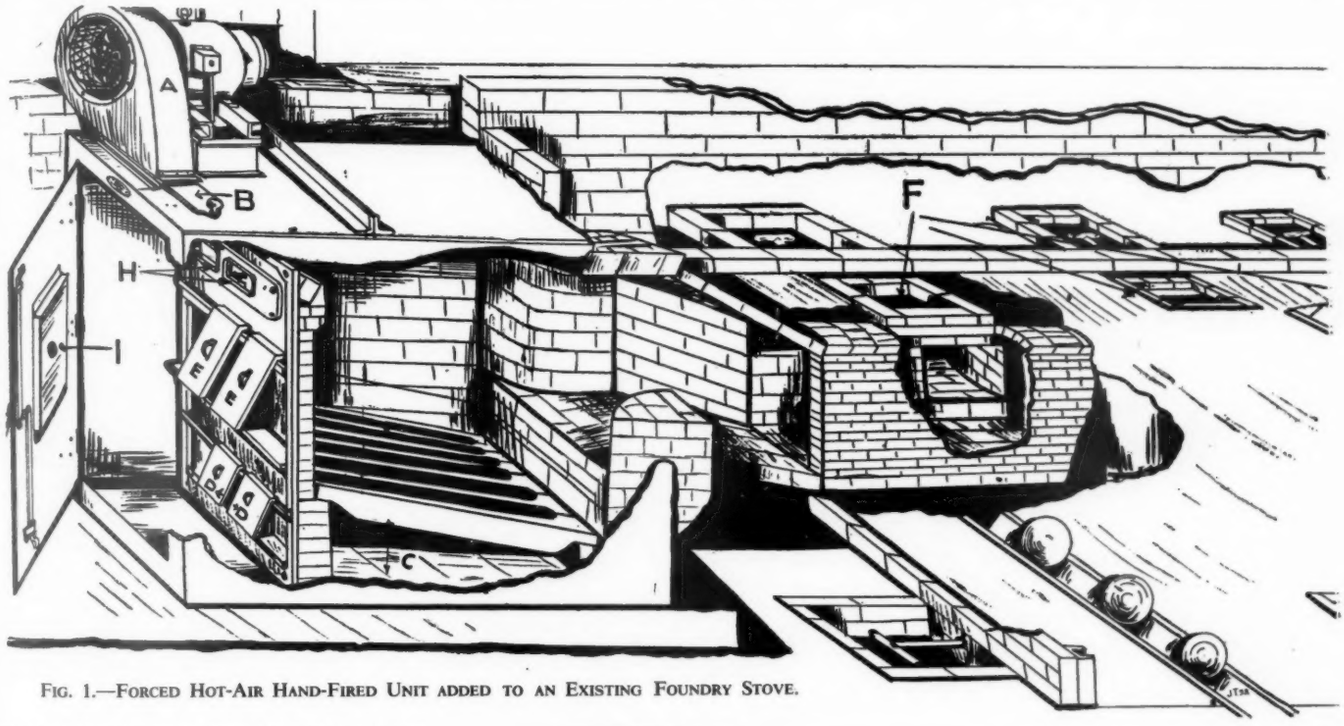


FIG. 1.—FORCED HOT-AIR HAND-FIRED UNIT ADDED TO AN EXISTING FOUNDRY STOVE.

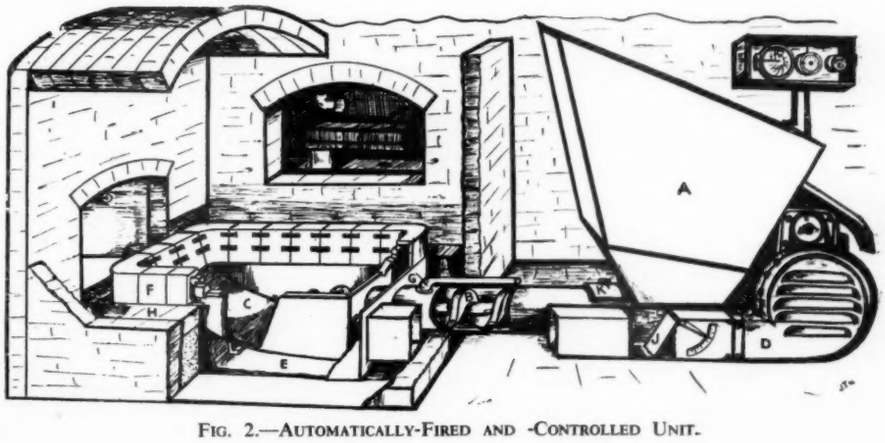


FIG. 2.—AUTOMATICALLY-FIRED AND -CONTROLLED UNIT.

gives a warning if this should happen; moreover, this feature also calls attention if for any other reason the unit comes to a stop.

Reference to the chart, Fig. 3 (a typical one) shows a consistent, gradually rising temperature line up to 590 deg. C. for mould drying. For sea-sand and binders, 400 to 450 deg. C. was set for, obtained and reliably kept to without difficulty. Two other devices were built into the electrical side; these added considerably to an already highly efficient unit, and contributed very much to the sought-for results regularly obtained.

A thermostat to cut in and out at—in this case—550 to 650 deg. C. was set to operate at 590 deg. C. The small dip at M, Fig. 3, shows the accuracy with which this operates, and so prevents the possibility of burnt moulds. A time switch is the other device referred to. This electrical unit will automatically start, run and stop the outfit at any required times when switched into use.

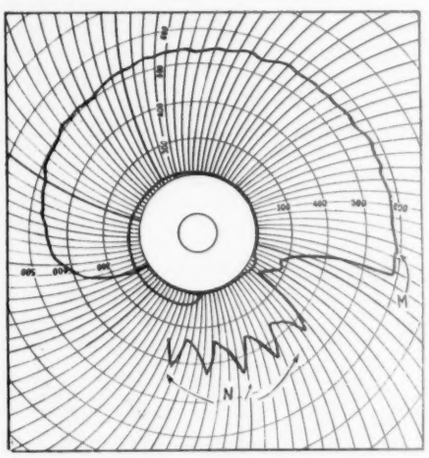


FIG. 3.—TEMPERATURE RECORD OBTAINED WITH AUTOMATIC-CONTROL UNIT.

The peaks N, Fig. 3, represent a 10-min. warm-up every hour for drying out an important reblacked mould, where any blacking "rat-tailing" or expansion cracks would thereby cause a rejected casting. The peaks also record the efficiency of the time switch.

As to economy, automatic stoking has much to recommend it, for coal as a fuel is easy to obtain. Moulds and cores, after drying, are quite free from the "sulphur coating" sometimes associated with coke and hand stoking. Combustion is so complete that there is no soot or greasy skin, which occasionally arises from coal and hand firing.

There are no firebars to renew or clinker-up. Tuyere design is robust and has ample section for long life, and at 12 months the original set had no evidence of depreciation.

Factors in the Production of Sand Castings in High Duty Iron

(*Concluded from page* 316.)

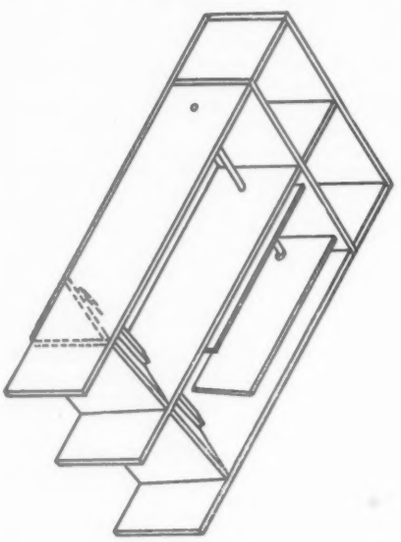
MR. FRANCIS, intervening, said that Dietert had done much work on this subject in America, and had evolved formulæ by means of which size of choke and height of runner could be calculated relative to weight and section thickness.

On the question of fluidity, MR. KING said it was mainly a question of correct distribution of metal in one mould which avoided trouble. He considered that the feeding methods mentioned by Mr. Slater would not be so good as top feeding. If rapid flow and squirting of the metal were prevented by opening the choke, liquid shrinkage was largely taken up as pouring progressed.

A Canadian Works Locker System

One company confronted with the problem of storing the street clothing of its women employees designed the method sketched to satisfy a number of conditions at once. It was not possible to furnish individual lockers and indeed space was not available to allow each girl an individual pigeon-hole, apart from the expense.

Two shifts are on duty at the plant; those on duty require accommodation for, at the worst condition, wet or snowy winter overcoats, and overshoes. Those off duty only require space for a smock or possibly a soiled overall. It is, of course, undesirable that any person's coat should come in contact with a grease-spot on an overall, for instance.



Each section of the rack is allocated to three girls; two on duty and one off under the extreme condition. A wire hanger is furnished for each, and the two short plywood panels in each section pierced to hang loosely from the supporting rod, may be slid from a "fat" position to a "lean" one as required.

Near the top of the sloping floor piece a cleat allows overshoes to be hooked under the heel—the section need be wide enough for only two pairs at a time. A width of 18 in. is found enough. The top pigeon-hole accommodates hats, combs and the like.—"Canadian Machinery and Manufacturing News."

(*Continued from previous column.*)

The speaker went on to propose the toast of the President, who briefly responded, and members then adjourned for the technical session.

Amongst those present at the luncheon who are prominent in the foundry industry were, in addition to Mr. W. B. Lake, the president of the Institute of British Foundrymen, Mr. V. C. Faulkner and Dr. J. E. Hurst, past presidents. Of reigning or past branch-presidents there were: Dr. C. H. Desch, F.R.S., Mr. V. Delport, Dr. Everest, Mr. Ambrose Firth, Mr. Barrington Hooper, C.B.E., Mr. C. H. Kain, and Mr. J. G. Pearce, director of the B.C.I.R.A. Other members of the industry present were: Major T. G. Bird, D.S.O.; Mr. D. F. Campbell, M.A.; Mr. Arnold Carr; Mr. J. Ferdinand Kayser; Mr. W. J. Kitching; Mr. H. Morrogh (B.C.I.R.A.); Col. H. K. Newcombe; Mr. A. S. Pye-Smith; Mr. W. F. Rowden; Mr. G. R. Shillitoe; Mr. J. A. Smeeton; Mr. G. E. Taylor; Mr. A. C. Turner, and Mr. F. Arnold Wilson.

The Iron and Steel Institute

(*Continued from page* 312.)

industry in relation to the affairs of the State will be seen in a new light, and then politics will not be regarded as the eccentricity of a few people but as the sphere of activity in which the great men of industry will be recognised as great men of their country and as great men of affairs. The time will come when great industrialists and politicians will not be regarded as point and counterpoint, but as people who have a joint responsibility for the welfare of their country, and who may very well be one and the same; and, when that happens, I believe that we shall develop enormous political power, of a kind that we have not previously realised.

The PRESIDENT, who responded, said "the presence in this country of the Prime Minister of Australia has been most stimulating and fortifying, and has been an inspiration to all of us. We welcome him to-day not only as a great statesman from a great country, but as coming from a country which has worthily maintained the high traditions of our industry. I recall the arguments of a few years ago, when those engaged in our industry in this country were unduly perturbed at the development of the industry in Australia, but we are thankful that, after all, the industry in Australia did develop, and on such sound foundations. Nature has been very kind to Australia in the wonderful facilities she has provided there for the making of steel, and which predestined Australia to take up steel-making. We are very grateful to the enlightened men in Australia who have developed the industry there on such sound lines, and who constantly came over here to make themselves acquainted with the latest developments.

In the old days, it was the skilful speculator who was regarded as the distinguished steelmaker. In those days it was the task of the Institute to uphold the technical and scientific side of the industry. To-day, however, the industry has come into its own, and we are realising more than ever that it is the scientific side of steel-making which is of the greatest benefit in a time of crisis, and I am thankful that the steel with which we are providing our Fighting Services is of such a quality that they can trust their lives to it, and is equal to that made anywhere in the world. In the pre-war years, the Institute made the younger men conscious of the value of research, and taught them never to be satisfied with what was being done, but always to be critical of what their fathers did and never to accept what their grandfathers had done, but to harness the new knowledge which was constantly put at their disposal. The industry had to-day rendered the State a service which would have been impossible had it continued to be conducted on what might be termed commercial lines.

Owing to the absence of Lord Dudley, who was to have proposed the toast of the guests, but who had been prevented by other important duties from doing so, the President went on to propose this toast, and paid a special tribute to the representatives present from Greece and other Allied countries and from the United States of America. In particular he referred to the presence of M. Josef Bech, the Minister for Foreign Affairs of Luxemburg, and recalled the happy memories of their visit to that country which many members of the Institute enjoyed.

M. JOSEF BECH, who responded, said that he probably owed the honour of doing so to two members of the Institute, Thomas and Gilchrist, whose invention of the basic converter process of steel manufacture had made it possible for the iron and steel industry of Luxemburg to assume great importance.

(*Continued at foot of next column.*)

ALUMINIUM ALLOYS AND HARDENERS

We are able to supply the virgin Aluminium Alloys and Hardeners listed opposite. These are produced under expert control and are released to the standards specified.

ALUMINIUM UNION LIMITED

LONDON · MONTREAL

The largest distributors in the British Empire of Aluminium and its Alloys in all commercial forms.

THE ADELPHI · STRAND · LONDON · W.C.2

CUT FOR REFERENCE

REFERENCE

ALUMINIUM ALLOYS AND HARDENERS

ALLOYS

	SPECIFICATION
No.160 *12% SILICON*	B.S.S./L33. D.T.D.231
No.161 *12% SILICON*	D.T.D.240 D.T.D.245
No.162 *LO-EX*	PISTON ALLOY
No.218 *'Y' ALLOY*	B.S.S./2L24 (B.S.S./L.35)
No.226	D.T.D.298. D.T.D.304 D.T.D.361
No.465	B.S.S./3L5

HARDENERS

20% SILICON

20% NICKEL

4% IRON

Enquiries to

ALUMINIUM UNION LIMITED

THE ADELPHI, STRAND, LONDON, W.C.2

TELEPHONE: TEMPLE BAR 7766

The Week's News in Brief

Trade Talk

FERODO, LIMITED, announce that their Manchester depot have now secured new premises at 33/41, Nelson Street, Chorlton-on-Medlock, Manchester, 13.

A CARGO of scrap given by the islanders of Mauritius to the people of Britain is now at a Lanarkshire steelworks. The material was brought to a Scottish port free of transport charges.

THIS YEAR'S ROYAL ACADEMY Art Exhibition includes a foundry subject in the shape of F. Dodd's picture, "Munition Workers in a Foundry," a water colour which has received the commendations of the critics.

AT THE HALF-YEARLY MEETING of the Middlesbrough branch of the National Union of Blastfurnacemen, Ore Miners, Coke Workers and Kindred Trades the district secretary (Mr. T. Walsh) appealed for the observance of agreements, especially regarding regular attendance at work. It was only a small percentage of members who caused trouble in this connection, he said.

THE BOARD OF TRADE reminds those affected by the business insurance scheme (which covers plant, machinery, office furniture, business equipment, etc.) that the days of grace allowed for taking out policies of insurance end on May 16. Persons who do not insure by then will be covered only from the date on which their application with premium is received.

FOLLOWING SIR CECIL WEIR'S appointment as Controller-General of Factory and Storage Premises, regional controllers have now been appointed to the Civil Defence regions. The date on which the control will operate will be announced shortly. From that date all Government departments will have to obtain the approval of the control, through the regional controllers, before acquiring factory or storage premises. A register of factory and storage premises is being compiled, which will show which premises could most readily be made available for other purposes.

THE EIRE GOVERNMENT has made an Order under the Emergency Imposition of Duties Act, substituting for the former duty of 60 per cent. (40 per cent. preferential) or ninepence (sixpence preferential) per article, whichever is the greater, a duty of 60 per cent. (30 per cent. United Kingdom and Canada) or one shilling (sixpence United Kingdom and Canada) per article, whichever is the greater, on certain domestic vitreous enamelled hollow-ware or wrought iron or wrought steel, including basins, bowls, baths, buckets, saucepans, cooking pots, jugs, etc. Provision exists in the new Order for importation under licence.

COMPREHENSIVE EXHIBITIONS illustrating the various methods of protection of glass in houses, factories and shops, glass substitution and ventilation and obscuration in the black-out, are being staged simultaneously at the following addresses:—(1) The Building Centre, 158, New Bond Street, London, W.1; (2) The Building Centre, 425, Sauchiehall Street, Glasgow, C.2; (3) The Manchester Municipal School of Art, Cavendish Street, All Saints, Manchester, 15; and (4) The Museum and Art Gallery, Queens Road, Bristol. Exhibits from more than 150 firms will be shown in London and all have been submitted to the Research and Experiments Department of the Ministry. Representatives of local authorities, surveyors, architects and the general public are invited to see samples of actual materials and equipment used to carry out the recommendations of the Ministry. A specimen of the new Morrison table shelter will be on view, as well as samples of shuttering for north lights and factory roofs.

A CO-ORDINATED SYSTEM of transport was visualised by Mr. John Miller at the annual meeting of the Grand Union Canal Company. He said that before the war competition between rail, road, canals and coastwise shipping had created such an impasse that no form of transport was receiving a fair reward, and enormous amounts of capital invested in these industries could never hope for even a moderate return. That state of affairs could be obviated by a system of co-ordination of all transport. Rate structures should be built up and differentials agreed in favour of the slower routes or methods, such as canals and coastwise shipping. Railway-owned or controlled canals should be transferred to canal undertakings, and on similar lines to the railway amalgamation four canal groups should be formed and given the necessary Government assistance to enable the transfers to take effect. The very heart of the canal industry from a traffic standpoint was in the Midlands, and real development could not take place until the railways released this stranglehold and ceased to be concerned with canals. Birmingham as a port was no dream, said Mr. Miller.

AN ENGINEERING ADVISORY COMMITTEE has been appointed to advise the Government upon engineering questions. The Committee will consider how the resources of the engineering profession can best be utilised in connection with the war work of Government departments; will nominate engineers who might suitably be invited to undertake particular tasks; suggest means of improving or supplementing the methods adopted by Government departments for utilising engineering science for war purposes; advise on problems referred to them in connection with the development of new engineering devices, on methods of bringing such devices speedily into production, and on means of meeting new war requirements in the engineering field; examine new ideas or devices in engineering likely to assist the war effort, and bring to the notice of the Government those which appear to merit further consideration by the department concerned. The Committee will consist of Lord Hankey (chairman); Lord Falmouth (vice-chairman); Sir Henry Tizard, F.R.S., and the following members, who have been selected after consultation with the Presidents of the Institutions of Civil, Mechanical, and Electrical Engineers:—Mr. J. R. Beard, Dr. A. P. M. Fleming, Mr. W. T. Halcrow, Dr. C. C. Paterson, Mr. H. R. Ricardo, F.R.S., and Principal A. Robertson, F.R.S.

Personal

MR. E. THOMPSON has been appointed chief mechanical engineer of the London & North Eastern Railway in succession to the late Sir Nigel Gresley. Mr. H. W. H. Richards has been appointed chief electrical engineer.

MR. W. A. WOODESON was elected president at the general meeting of the North East Coast Institution of Engineers and Shipbuilders. Mr. Woodeson is chairman of Clarke, Chapman & Company, Limited, and Clyde Crane & Booth, Limited.

MR. W. G. TUBMAN has succeeded MR. T. H. GIBSON as secretary of the British Iron and Steel Federation. Mr. Tubman was previously personal assistant to Mr. J. M. Duncanson, Deputy Controller of steel supplies under the Ministry of Supply. Mr. Gibson has been appointed a director of the Corporation.

Wills

MORGAN, SIR CHARLES L., past-president of the Institution of Civil Engineers	£143,634
HARGREAVES, A. F., chairman of Hargreaves & Redfern, Limited, metal merchants, Manchester	£7,922
ALLAN, J. B., of Prestwick, late vice-chairman and managing director of David Colville & Sons, Limited, and director of Archibald Russell, Limited	£113,011

Foundry Coke Merchants' Association

The views of foundry coke merchants throughout the country will find expression in future through a new organisation, having the above name, which has been formed to watch over their interests. It had its birth at an influential and well-attended meeting held at Sheffield on April 30, over which Mr. Arnold Carr, a director of Messrs. Thos. W. Ward & Company, Sheffield, presided. Mr. Carr was elected the first chairman, and Mr. A. Dudley Evans, secretary of the Birmingham Exchange, is secretary. The adherence of the existing London Association will be a source of strength to the new organisation. The London body is represented on the committee by three members, and while retaining its identity and dealing with matters concerning its own membership in particular, will be identified in all national questions with the Association just established.

Obituary

WE REGRET to announce the death of Mr. W. W. Myers, at his residence, "Ardenconnel," Stokesay Road, Ashton-on-Mersey. Mr. Myers, who was in his 60th year, joined the Carborundum Company, Limited, in 1903. For many years he had held the position of office manager, in which capacity his kindly and sympathetic nature made him the most beloved and popular member of the staff. His passing means to the staff the loss of a friendly advisor, and brings to an end a long and loyal service to his firm.

Company Meeting

International Nickel Company of Canada, Limited

The annual meeting of the International Nickel Company of Canada, Limited, was held in Toronto last week. MR. ROBERT C. STANLEY (chairman and president), who presided, said that the duty of the management under wartime conditions was to provide an adequate supply of nickel, copper, and platinum metals to meet all demands for the war programmes of Canada and Great Britain. Furthermore, the defence programme of the United States Government, in conjunction with its policy of aid to Britain, was adding heavily to the toll on their output of nickel. To meet the situation they had not only continued their programme of balancing smelter and refinery capacity with mine output, but had augmented and accelerated this programme by making plant extensions wherever possible and utilising all available facilities. In addition, they were treating and refining the entire Bessemer matte output of Falconbridge Nickel Mines, Limited. Due to these efforts nickel output was increased in 1940, and was being further expanded this year.

Reports and Dividends

Robey & Company, Limited—Dividend of 5 per cent. (same).

Moss Gear Company, Limited—Interim dividend of 7½ per cent.

Joshua Bigwood & Son, Limited—Interim dividend of 5 per cent.

Walter Spencer & Company, Limited—Interim dividend of 5 per cent. (same).

A. C. Wickman, Limited—Final ordinary dividend of 7½ per cent. (5 per cent. a year ago), making 12½ per cent. (10 per cent.).

Allen West & Company, Limited—Net profit for the year to January 31, £51,931 (£62,654); dividend for the year of 7½ per cent. (same).

Laurence Scott & Electromotors, Limited—Profit for 1940, £119,178 (against £123,314); dividend on the "A" and "B" ordinary shares of 15 per cent. (same).

Herbert Morris, Limited—Interim dividend for the year ended July 31 on the ordinary shares of 5 per cent., free of tax (against 7½ per cent., free of tax, a year ago).

William Beardmore & Company, Limited—Trading profit for 1940, after providing for depreciation and taxation, £360,499 (compared with £494,629); total with miscellaneous income, £375,094 (£513,674); net profit, after charging debenture interest and income tax, £328,679 (£465,063); to war contingencies reserve, £200,000; dividend on the ordinary stock of 10 per cent. (same); carried forward, £215,145 (£166,147).

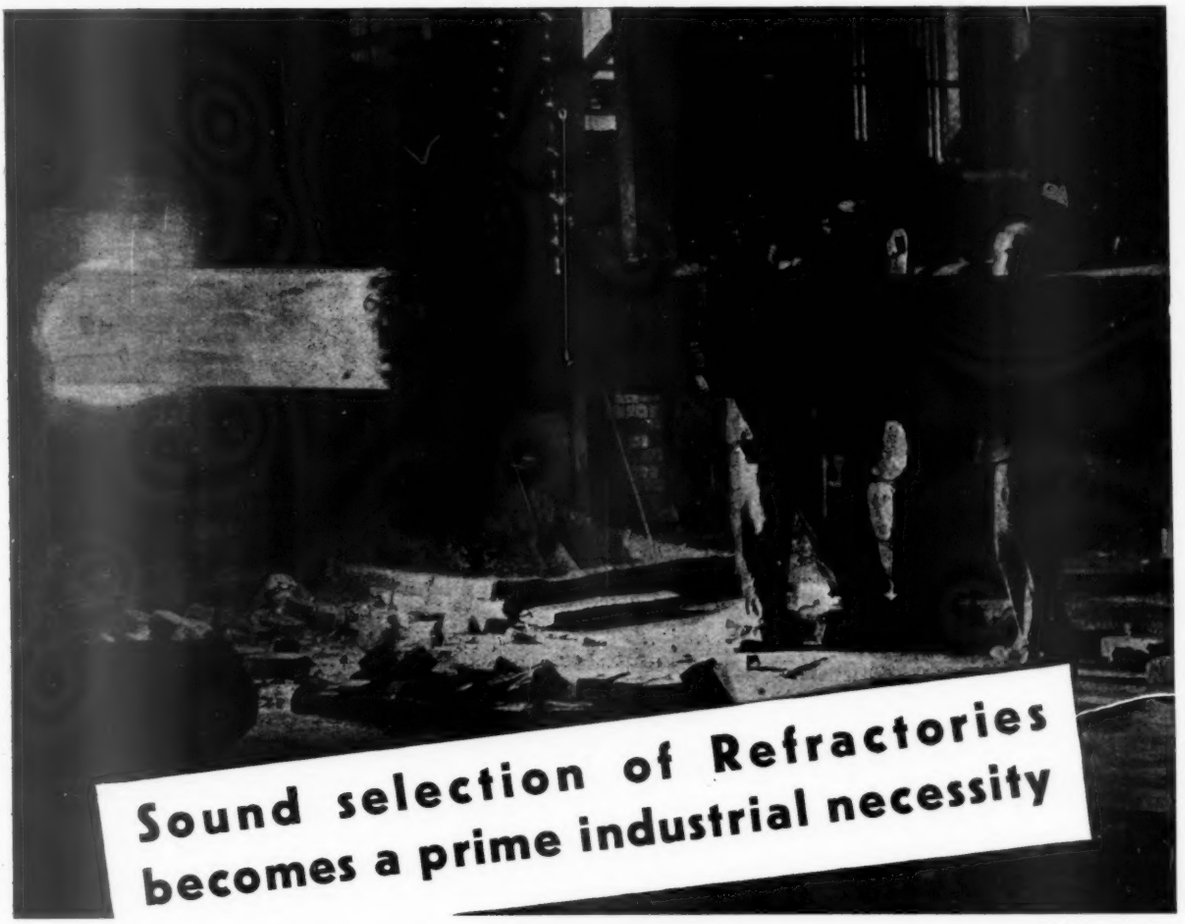
Contracts Open

Waterford—Supply of water mains; specials; lead piping; pipe-cutting gear, for the Town Council. Mr. D. A. Hegarty, city manager and town clerk, City Hall, Waterford.

Atherton, May 17—Cast-iron concentric cable boxes, etc., during the year ending March 31, 1942, for the Urban District Council. The Electrical Engineer, Electricity Department, Factory Street, Atherton.

Letterkenny, May 12—Supply and erection of a pair of 45-b.h.p. Diesel oil engines and electric generators, complete with switchgear and control gear, for the Committee of Donegal Mental Hospital. Mr. P. J. Courtney, resident medical superintendent. (Fee £5, returnable.)

WHEN ONLY **PRODUCTION** COUNTS



For the institutions we all hold dear, British Industry, both men and management, are working with an intensity and will-to-win unique in our history. Refractories cradle almost every item of war equipment—ships, planes, tanks, guns, and so on. Never before has the choice of suitable refractories held greater consequences. The life of furnace structures must reach its maximum, and repair time minimised. In the choice of a refractory—'G.R.' engineers can be of much assistance to you. A wealth of experience is backed by a comprehensive range of famous products, which—when selected and applied to suit service conditions—will yield maximum life and dependability. 'G.R.' invite your enquiries which will receive the most careful consideration.

GENERAL REFRACTORIES LTD.

HEAD OFFICE: GENEFAX HOUSE, SHEFFIELD, 10. TELEPHONE 31113 (6 LINES)

G.P.12

FIREBRICKS: *Glenboig Special, Glenboig Special Crown, Glenboig, Glenboig Crown, Castlecary, Dykehead, Gem, White Carr, Stour, Hycone, Alumantine, Hysilyn, Adamantine, Llangennech.*
BASIC BRICKS: *Spinella, Saxpyre, Supermag, Diazite, Dolomax.*
ACID-PROOF REFRACTORIES: *Obsidianite, Losol.*

INSULATION: *Amberlite* Bricks, Cement and Concrete.
SILICA BRICKS: *Lowood, Meltham, Allen, Quartex.*
CEMENTS: *Sintex, Durax, Pyrolyte.* PLASTICS: *Durax, Rotaline, Plastic K-N., Glendoline, Ground Ganister, Steel Moulders' Compositions.* SILLIMANITE: *Tank Blocks, Bricks and Cements.* SANDS: *Moulding, Brick Facing, Silica, Glass.*

Raw Material Markets

While a fairly large quantity of imported iron is still passing into consumption, the position of the iron trade is by no means unsatisfactory considering the nature of the demands made upon it and the inevitable dependence it has on foreign ores. Ironfoundries' requirements are being coped with in a gratifying manner, on the whole, but this can only be achieved by the careful scrutiny of applications for supplies. High-phosphorus iron, which is produced from home ores, is in plentiful supply, largely due to the fact that the chief consumers of this grade—the light-castings foundries—are not working on a full-scale programme of production. Nevertheless, demand for high-phosphorus qualities tends to increase week by week, as larger quantities of this iron are being used by foundries engaged on heavy products, because of the more difficult conditions obtaining with regard to supplies of low-phosphorus iron, hematite, and other higher quality materials manufactured from imported ores.

Pig-Iron

MIDDLESBROUGH—Busy conditions continue among the heavy engineers on the North-East Coast, while some improvement is discernible in the light-castings trade, which appears to be getting a larger share of Government contracts, with the prospect of further orders from this source. Foundry iron is coming forward from the Midland furnaces regularly, and all demands are being met satisfactorily. In fact, ironmakers seem to be in a position to cope with any increase in consumption which may eventuate.

Licences for the purchase of hematite are being granted only in the case of high-priority consumers, and strong measures of economy are being exercised all round, as local output does not cover even the requirements of essential users. Moderate tonnages are still being brought in from overseas, but imports are restricted to bare necessities. While consumption of hematite is rising in certain quarters, many users have been able to utilise other grades of iron in their mixtures, and this practice, in the aggregate, represents a fairly substantial saving.

LANCASHIRE—No difficulty is encountered in obtaining supplies of foundry pig-iron from the Midlands. Consumption is at a high level, especially in the heavy engineering branch, where fully active conditions prevail. On the other hand, requisitions of iron by the jobbing foundries and the makers of light castings are at a comparatively low level; nor is any early improvement likely in these trades. While furnaces are able to cope with day-to-day demands for iron, many of them have substantial delivery arrears to make up under contracts.

MIDLANDS—The chief activity in the iron trade continues to be in special grades, demand for which ensures a disposal of full outputs and, in fact, supplies brought into the country from abroad are being used to make up a deficiency in home production. Heavy castings of all descriptions are in very strong request by Government departments, entailing the use of large tonnages of low-phosphorus, hematite and refined irons, together with quite a fair quantity of high-phosphorus material, which, although chiefly used by light-castings makers in the normal way, is now incorporated in the mixtures of heavy engineers. Fortunately, plentiful supplies of high-phosphorus iron are available, as this iron is produced from home ores and the demand for it from the light-castings industry is well below the average level of peacetime. Special irons are only distributed to priority consumers, but all urgent requirements are being dealt with satisfactorily.

SCOTLAND—Heavy founders' demands for iron are only just covered by present deliveries, and no provision is made for the accumulation of stocks. However, urgent calls are promptly met, and there are no instances of foundries being held up through lack of supplies. Business in light castings remains rather quiet and many makers are poorly employed. The few firms in this branch which have acquired a certain volume of Government work are, of course, better situated than the remainder of the industry. Iron for the steel plants is in full request.

Coke

Good contract deliveries of foundry coke are being made to consuming points, most buyers having covered themselves over some period ahead. In this respect the ovens stipulate that the price paid shall be that ruling at the time of delivery, as the Control authorities reserve the right to alter quotations when a change is considered desirable. For delivery to Birmingham and Black Country stations, the current price of Durham best foundry coke is 61s. 6d. per ton. In addition to there being substantial stocks of fuel on hand at the ovens, many consumers also have reserves, and they will be keen to fill their storage accommodation to the utmost limit during the summer.

Steel

While certain grades of ordinary commercial steel are in somewhat reduced demand, pressure on special descriptions is increasing rapidly, and very large tonnages are being taken up for the manufacture of munitions and aircraft, etc. The call for special qualities of steel will become even more intensive with the coming into operation of further Government projects, and production will have to be expanded correspondingly. Structural engineers are receiving satisfactory deliveries of steel, and the demand from this source, which has recently developed a stronger tendency, is fully maintained. Shipbuilders' requirements of plates are very substantial, while there is also a good call for these from other consumers, and delays in despatch is unavoidable at times, although priority users' needs are being well cared for.

Scrap

While deliveries of iron and steel scrap are on a heavy scale, despatches, generally, fall below requirements, due not only to inadequate supplies, but also to transport delays and shortage of labour. Every effort is being made to solve these difficulties, and it is obvious that considerable success is attending these efforts, as deliveries in many respects have improved during the past week or two. Nevertheless, there is much leeway to make up before all demands are satisfied promptly.

Metals

TIN—An extra-ordinary general meeting of the International Tin Committee is to be held on May 15 in London for the purpose of drawing up a draft agreement for the next restriction period, which, if control is to be continued, will operate from the first day of next year. It is understood that a recommendation as to standard tonnages, believed to be based on output at 130 per cent. of standards for the year to June, 1941, has been sent to the signatory Governments for approval, but no reply has been received. Consequently, the draft agreement to be worded at the meeting will not include any figures relative to standard tonnages. The Bolivian Government seems likely to agree to the standard tonnages for that country suggested in the Committee's recommendations, but, owing to Japanese pressure, the position of Thailand is uncertain. In some circles it is believed that Japan is attempting to lure Thailand away from the restriction scheme and to persuade that country to sell her tin production (about 18,000 tons in 1940) to the Axis Powers. While this loss of output would not be serious in itself, added to other uncontrolled sources of output, it might compel signatories to operate on lower standard tonnages in order to maintain the structure of world prices.

The London tin market tends to follow developments in the United States and in the East fairly closely. Business in the U.S.A. is rather quieter, although the turnover remains substantial. As in this country, tinplate operations in the United States are restricted by the quantity of steel forthcoming for the trade, and the American industry is working at around 85 per cent. of capacity; this is an improvement and follows the receipt of considerable orders recently. Delays in deliveries appear to be quite lengthy at times.

The Statistical Bulletin of the Tin Research Institute estimates world production of tin in March at 21,900 tons, compared with 17,600 tons in February. Production for the first quarter was 56,700 tons, against 52,600 tons in the corresponding period of 1940. United States deliveries totalled 16,092 tons in March, against 12,195 tons in February. U.S. deliveries for the first quarter were 41,047 tons, compared with 25,624 tons in the corresponding period of 1940. Tin consumption of the United Kingdom was 2,155 tons in February, 1941, against 2,672 tons in January and 2,450 tons in February, 1940. World stocks of tin, including smelters' stocks and carry-over, decreased by 3,177 tons during March to 54,526 tons at the end of the month. Stocks at the end of March, 1940, were 47,232 tons. According to Mr. W. H. Gartsen (Henry Rogers, Sons & Company), the total visible supply of tin on April 30 was 35,086 tons, against 35,252 tons at the end of the previous month. The carry-over in the Straits Settlements was 1,961 (2,209) tons, while the carry-over at the principal European smelters was 2,098 (2,946) tons. Deliveries of tin during April were:—United States, 13,955 tons (16,092 in March); United Kingdom, 954 (1,116) tons; other countries, 1,962 (1,641), making a total of 16,871 (18,849) tons.

Tin prices on the London Metal Exchange during the past week have been as follow:—

Cash—Thursday, £269 15s. to £270; Friday, £270 10s. to £270 15s.; Monday, £269 5s. to £269 10s.; Tuesday, £269 5s. to £269 10s.; Wednesday, £270 5s. to £270 15s.

Three Months—Thursday, £267 to £267 5s.; Friday, £267 to £267 10s.; Monday, £265 15s. to £266; Tuesday, £266 5s. to £266 10s.; Wednesday, £267 5s. to £267 10s.

COPPER—While copper entering this country is reserved almost exclusively for the use of works on the lists of Government departments, comparatively few restrictions have as yet been made on the use of the red metal in the United States, where the supply position is causing some concern. Consumption in America continues to expand and may be expected to increase steadily with the placing of further defence orders, so that it would appear that early steps should be taken for the closer regimentation of the metal to urgent requirements. In addition to the absence of strict control over distribution, the existing supply situation has been brought about by the policy of the American Administration of urging that neither primary nor Custom producers shall eventually charge more than 12 cents to domestic users, the result of this being that certain mines at which costs of production are high are left out of commission. Efforts are being made to secure a subsidy for these mines or a higher domestic quotation, but so far representations have not resulted in any change in official policy. The authorities, of course, have access to the output of Latin-American copper producers, and large tonnages of metal are likely to be absorbed by North American consumers during the coming months.

SPELTER—Owing to the shortage of zinc, a number of American galvanisers have lately laid idle their plant. The position is undoubtedly tight, but it is felt that the needs of essential users are being met and fully looked after by the authorities. In the past ordinary users of the metal have not had any great difficulty in procuring supplies of spelter, but it is likely that, in the interests of the defence programme, the methods of distribution will be more closely controlled. Actually, the zinc sources of supply open to American industry should be easily sufficient to satisfy the increased demands of "wartime" consumption, and it is largely the very heavy buying by private consumers of late which has brought about the present stringency.

LEAD—While supplies of other non-ferrous metals have to be carefully conserved, both here and on the other side of the Atlantic, there is rather more latitude possible in the distribution of lead, which is in good supply.